NJSC «Kazakh National Research Technical University named after K.I. Satpayev»
Institute of Geology, Petroleum, and Mining Engineering
Petroleum Engineering Department

EDUCATIONAL PROGRAM

"PETROLEUM ENGINEERING"
(scientific and pedagogical direction (2 years))

Master of Engineering Science
7M07202 – «Petroleum Engineering»

2nd-edition
in accordance with the 2018 State Mandatory Educational Standards for Higher and Postgraduate Education

Almaty 2021

СӘТБАЕВ УНИВЕРСИТЕТІ SATBAYEV UNIVERSITY

The education program was developed by the faculty of the Department of Petroleum engineering

PE Department Head – Yeligbayeva G.

agreed:

Director of G&OGB Institute Syzdykov A.

From employers:

1. Arman Zhamankulov, Director of asset management at Shell Kazakhstan Development
2. Amangali Nysangaliev, Doctor of Technical Sciences, Advisor to the Director of KMGP LLP
3. Iskander Gusenov, Engineer in "Institute of Polymer Materials and technologies"
4. Askar Munara, Director of LLP "Kazakh Scientific Research Geological Exploration Oil Institute"

From the academic partner:

1. Sergey Lvov, Professor of the "Pennsylvania State University (USA)

Approved at a meeting of the Educational and Methodological Council of the Kazakh National Research Technical University named after K.Satpayev. Minutes No 3 dated 25 June, 2021

Qualification:
Level 7 of the National Qualifications Framework:
7B07 Engineering, manufacturing and construction industries
7B072 Manufacturing and processing industries (bachelor)

Professional competence: Organization and management of processes and technologies for drilling oil and gas wells, field development, production and transportation of oil and gas, plan and conduct analytical, simulation and experimental studies, critically evaluate data.

CONTENT

BRIEF DESCRIPTION OF THE PROGRAM

The purpose of developing an educational program

The main professional educational program (EP) of the magistracy, implemented by the Kazakh National Research Technical University named after K.I. Satpayev and approved by the Ministry of Education and Science of the Republic of Kazakhstan in the field of training "Petroleum Engineering" is a system of documents developed and approved taking into account the requirements of the labor market on the basis of the state educational standard of higher education.

EP regulates the goals, expected results, content, conditions and technologies for the implementation of the educational process, assessment of the quality of the graduate's training in this area of training and includes the curriculum, work programs of modules / disciplines, internship programs, state final certification and other materials to ensure quality education.

The development and management of the educational program of postgraduate education "Petroleum Engineering" is carried out in accordance with the standard and working curriculum for the specialty 05070800 "Oil and Gas Business", developed by the Kazakh National Research Technical University named after. KI Satpaev and approved in the prescribed manner.

The educational program presented for accreditation meets the requirements of the State Compulsory Standard for Postgraduate Education. The implementation of the educational program and the strategy of its development is carried out by the Department of "Petroleum Engineering" of the Institute of Geology and Oil and Gas Business named after K. Turysov.

The main purpose of the training program is:

- the formation of general cultural competencies of graduates (competencies of social interaction, self-organization and self-government, of a systemic activity nature), the implementation of a competent approach in the formation of general cultural competencies of graduates should be ensured by a combination of educational and extracurricular work; the socio-cultural environment necessary for the all-round development of the individual;
- formation of general professional and professional competencies of graduates.

A Master's program is an educational research work containing in-depth theoretical and (or) experimental and practical research of a fundamental and (or) applied nature.

Normative documents used to develop this EP

Legal framework and recommended methods used for the development of the EP "Petroleum Engineering":

– Law of the Republic of Kazakhstan dated July 27, 2007 No. 319-III "On Education";

– Resolution of the Government of the Republic of Kazakhstan dated August 23, 2012 No. 1080 “On approval of state compulsory education standards for the corresponding levels of education”;

– Decree of the Government of the Republic of Kazakhstan dated May 17, 2013 No. 499 "On approval of the Model Rules for the Activities of Educational Organizations of the appropriate types, including the Model Rules for Educational Organizations Implementing Additional Educational Programs for Children" (as amended on April 7, 2017);

– State compulsory education standard ГОСО 03.08.334.-2006 in specialty 050708 - "Oil and gas business";

– Other regulatory and methodological documents of the Ministry of Education and Science of the Republic of Kazakhstan;

– Sectoral qualifications framework for oil and gas, oil refining and petrochemical industries, Astana, 2017, http://www.kazenergy.com/upload/document/industry-frame/ork.pdf (last accessed October 8, 2021);

– Guidelines for the development and execution of sectoral qualifications frameworks, Astana, 2016, http://atameken.kz/uploads/content/files/Method%20%20ORK%202016.pdf (last accessed on October 8, 2021);

– The working curriculum for the specialty "Oil and Gas Business", approved by the rector of the Kazakh National Research Technical University named after K.I. Satpayev;

– Documents of the TQM (General Quality Management) system on the organization of the educational process at the Kazakh National Research Technical University named after K.I. Satpayev;

– SPE (Society of Petroleum Engineers) Petroleum Engineering Curriculum Example, https://www.spe.org/members/docs/Model-Petroleum- Engineering-Curriculum.pdf (last accessed October 8, 2021);

– SPE Technical Knowledge Matrix for Engineering Graduates, http://www.spe.org/training/docs/graduating_matrix.pdf (last accessed October 8, 2021

– SPE Competency Matrices, https://www.spe.org/training/competency.php (last accessed October 8, 2021);

General provisions in the development of EP

As shown in Figure 1, the provisions defining a quality EP start with clear and concise Program Educational Objectives (hereinafter referred to as PCO), which are closely related to the mission of the program. In addition, the CSP determines the expected knowledge and skills of students upon graduation. EP "Petroleum Engineering" in the formation of knowledge and skills of students at the end of their studies was based on Criterion 3 ABET (Accreditation Council for Engineering and Technology) - Student Outcomes, since among engineering disciplines ABET accreditation is considered prestigious and highly recommended.

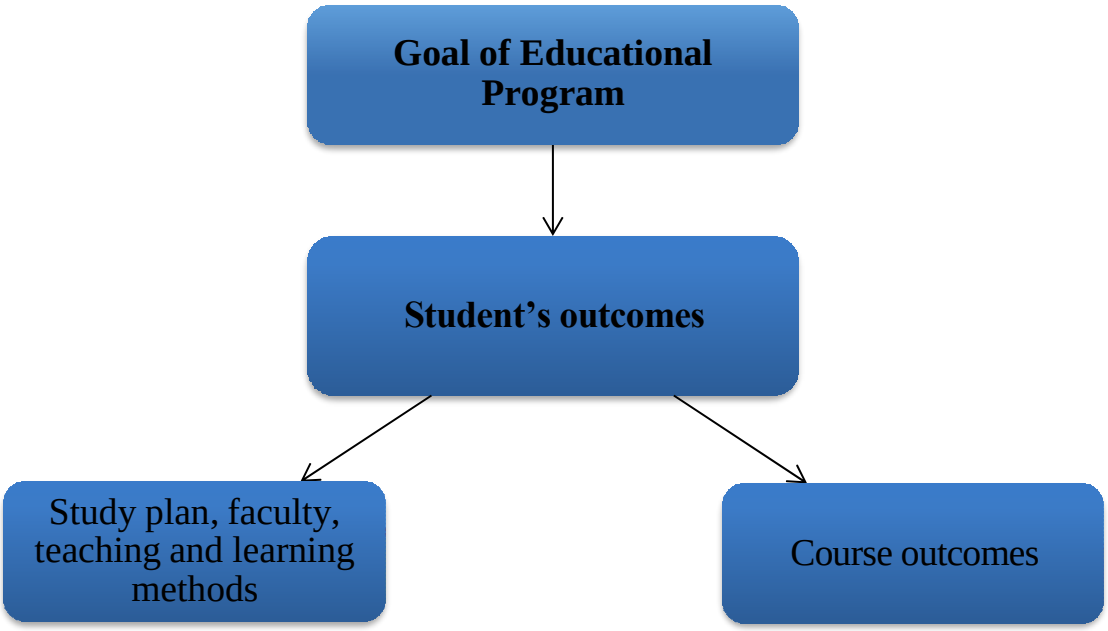

Figure 1 - The relationship of different components in the definition of the educational program

Professional and labor activity

– A field of professional activity or a professional group is a set of types of labor activity in an industry that has a common integration basis (similar or similar purpose, objects, technologies, including labor tools) and assuming a similar set of labor functions and competencies for their implementation.

– The type of labor activity or professional subgroup is a part of a professional group, a set of professions, formed by an integral set of labor functions and the competencies necessary for their implementation.

– The area of professional activity of masters includes research and development, methodology and methods of design and construction, implementation and management of technological processes and production in the fuel energy segment, including the construction of wells on land and offshore, and field development. Possible

places of work: manufacturing organizations, service companies, research and design organizations, etc.

– Table 1 indicates five core fields of professional activity and 21 types of job activities for graduates of EP "Petroleum Engineering" in according with the sectoral qualifications framework. It should be noted that when developing the EP "Oil Engineering", the experience of the world oil and gas industry was taken into account in the classification of the main areas of professional activity. For example, the current RBC classification is missing the direction "Development of oil and gas fields" - physical and chemical methods, mechanisms, and processes occurring in the reservoir and a qualitative description of these phenomena. Thus, the OP "Oil Engineering" includes the best world practices of the oil and gas industry, at the same time based on the existing historical traditions.

Table 1 - Areas of professional and work activities in the oil and gas industry, according to the ORC (7-level: master's degree)

Professional group	**Professional subgroup**
Exploration of oil and gas	Geological and geophysical survey for oil and gas exploration
Drilling oil and gas wells	Drilling management
Production of oil and gas	Production of oil and gas wells
	Maintaining reservoir pressure
	Underground well workover
	Well workover
	Oil and gas treatment and pumping
	Well survey
	Manufacturing control
	Operation of oil pipelines
Oil transportation	Oil transportation services
	Operation of equipment
	Diagnostics of equipment and linear part of main oil pipelines
	Maintenance of electrochemical protection equipment
	Manufacturing control

Gas transportation	Operation and repair of HST, gas facilities
	Operation and repair of the linear part of the pipeline
	Operation and repair of PS
	Transport operations of pipeline
	Production of oil and gas wells

Contacts

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PASSPORT OF THE EDUCATIONAL PROGRAM

1. Scope and content of the program

The term of study in the master's program is determined by the amount of acquired academic credits Upon mastering the established amount of academic credits and achieving the expected learning outcomes for obtaining a master's degree, the master's educational program is considered fully mastered. In the scientific and pedagogical magistracy, at least 120 academic credits for the entire period of study, including all types of educational and scientific activities of the master student.

The planning of the content of education, the method of organizing and conducting the educational process is carried out by the university and the scientific organization independently on the basis of the credit technology of education.

The master's degree in scientific and pedagogical direction implements educational programs of postgraduate education for the preparation of scientific and scientific and pedagogical personnel for universities and scientific organizations with in-depth scientific, pedagogical and research training.

The content of the Master's degree program consists of:

1) theoretical training, including the study of cycles of basic and major disciplines;
2) practical training of undergraduates: various types of practices, scientific or professional internships;
3) research work, including the implementation of a master's thesis - for a scientific and pedagogical magistracy
4) final certification.

The EP Objectives:

Training of highly qualified competent specialists in the oil, gas and transport sectors of the economy of the Republic of Kazakhstan, capable of quickly adapting to rapidly changing socio-economic conditions.

The objectives of the preparation for the program are to master the basic educational programs of the master's program, which includes the study of the following educational cycles:

–general scientific cycle;
–professional cycle; and sections:
–practice and research work;
–final state certification.

Each educational cycle has a basic (compulsory) part and a variable (profile) part set by the university. The variable (profile) part makes it possible to expand and (or) deepen knowledge, skills, skills and competencies determined by the content of the basic (compulsory) disciplines, allows students to acquire in-depth knowledge and skills for successful professional activity and (or) continuing professional education in doctoral

studies.

The term for mastering the Oil Engineering OP is 2 years.

2. Admission Requirements

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established sample and confirm the level of knowledge of the English language with a certificate or diplomas of the established sample.

The procedure for admitting citizens to magistracy is established in accordance with "Typical rules for admission to training in educational organizations that implement educational programs of postgraduate education."

The formation of a contingent of undergraduates is carried out by placing a state educational order for the training of scientific and pedagogical personnel, as well as paying for training at the expense of citizens' own funds and other sources. The state provides citizens of the Republic of Kazakhstan with the right to receive, on a competitive basis, in accordance with the state educational order, free postgraduate education, if they receive education of this level for the first time.

At the "entrance", a master's student must have all the prerequisites necessary for mastering the corresponding educational master's program. The list of required prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the master student is allowed to master them on a paid basis.

2. Requirements for completing studies and obtaining a diploma

Awarded degree / qualifications: A graduate of this educational program is awarded an academic degree "Master" in the direction of "Oil and Gas Business".

A graduate who has mastered master's programs must have the following general professional competencies:

– the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activity, develop their innovative abilities;

– the ability to independently formulate research goals, establish a sequence for solving professional problems;

– the ability to apply in practice the knowledge of fundamental and applied disciplines that determine the focus (profile) of the master's program;

– the ability to professionally choose and creatively use modern scientific and technical equipment for solving scientific and practical problems;

– the ability to critically analyze, represent, defend, discuss and disseminate the results of their professional activities;

– proficiency in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;

– willingness to lead a team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences;

– the readiness for communication in oral and written forms in a foreign language to solve the problems of professional activity.

A graduate who has mastered the master's program must have professional competencies corresponding to the types of professional activity that the master's program is focused on:

– *research activities:*

– the ability to form diagnostic solutions to professional problems by integrating the fundamental sections of science and specialized knowledge gained during the master's program;

– the ability to independently conduct scientific experiments and research in the professional field, generalize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;

– the ability to create and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge in the field of oil and gas business:

– *research and production activities:*

– the ability to independently carry out production and research and production field, laboratory and interpretation work in solving practical problems;

– the ability to professionally operate modern field and laboratory equipment and instruments in the field of the mastered master's program;

– the ability to use modern methods of processing and interpreting complex information to solve production problems;

– *project activity:*

– the ability to independently compose and submit projects of research and development work;

– readiness to design complex research and development work in solving professional problems;

– organizational and management activities:

– the readiness to use the practical skills of organizing and managing research and development work in solving professional problems;

– the readiness for the practical use of regulatory documents in the planning and organization of scientific and industrial work;

– scientific and pedagogical activity:

– the ability to conduct seminars, laboratory and practical exercises;

– the ability to participate in the management of the scientific and educational work of students in the field of oil and gas business.

When developing a master's program, all general cultural and general professional competencies, as well as professional competencies related to those types of professional activities that the master's program is focused on, are included in the set of required results of mastering the master's program.

4. WORKING CURRICULUM OF THE EDUCATIONAL PROGRAM

4.1. Duration: 2 years

WORKING CURRICULUM
OF THE EDUCATIONAL PROGRAM
7M07202 – «Petroleum Engineering»
of the 2021 - 2022 academic year

year of study	Code	Name of course	Component	Total amount in loans	Total hours	classroom volume lec/ lab/ pr	SRS (including SRSP), in hours	Prerequisites	Code	Name of course	Component	Total amount in loans	Total hours	classroom volume lec/ lab/ pr	SRS (including SRSP), in hours	Prerequisites
1	**1 semester**								**2 semester**							
	LNG 210	Foreign language (professional)	BD IC	5	150	0/0/3	105		AAP 244	Pedagogical practice	BD IC	4				
	HUM 208	Management psychology	BD IC	3	90	1/0/1	60		HUM 210	History and philosophy of science	BD IC	4	120	1/0/1	90	
	PET 266	Theory of motion of gas-liquid mixtures	PD IC	5	150	2/0/1	105		HUM 209	Higher school pedagogy	BD IC	4	120	1/0/1	90	
		Optional component	BD OC	5	150	2/0/1	105			Optional component	BD OC	5	150	2/0/1	105	
		Optional component	BD OC	5	150	2/0/1	105			Optional component	PD OC	5	150	2/0/1	105	
	PET 263	Research seminar for petroleum graduates	PD IC	5	150	1/0/2	105			Optional component	PD OC	5	150	2/0/1	105	
	AAP 242	Master's student scientific research, including an internship and a master's thesis	MS SR	6					AAP 242	Master's student scientific research, including an internship and a master's thesis	MS SR	6				
		In total		**34**						**In total**		**33**				
2	**3 semester**								**4 semester**							
		Optional component	PD OC	5	150	2/0/1	105		AAP 243	Research scientific training	PD OC	7				
		Optional component	PD OC	5	150	2/0/1	105		ECA 205	Registration and defense of the master's thesis (RaDMT)	FA	12				

		Optional component	PD OC	5	150	2/0/1	105									
		Optional component	PD OC	5	150	2/0/1	105									
		Optional component	PD OC	5	150	2/0/1	105									
	AAP 242	Master's student scientific research, including an internship and a master's thesis	MS SR	6					AAP 242	Master's student scientific research, including an internship and a master's thesis	MS SR	6				
		In total		**31**						**In total**		**25**				

CATALOG OF DISCIPLINES

Year	Code of elective	Code	Name of profile disciplines	Cycle	Credits	lec/lab/pra	Prerequisites
1	1203	PET228	Advanced Petrophysics	B	5	2/0/1	PHY111
		PET229	Advanced Reservoir Engineering			2/0/1	PET418
		PET232	Advanced Production Engineering			2/0/1	PET438
		PET211	Petroleum Reservoir Simulation: Compositional model			2/0/1	MAT103
		PET226	Principles of Reservoir engineering			2/0/1	PET431
		PET213	Enhanced oil recovery			2/0/1	PET173
	1204	PET262	Basic Coding for Petroleum Engineers	B	5	2/0/1	CSE677
		PET230	Advanced Thermodynamics and Phase Behavior of Reservoir Fluids			2/0/1	PET409
		PET227	Principles of production engineering			2/0/1	PET439
		PET246	Principles of drilling technology			2/0/1	PET431
		PET247	Principles of designing oil and gas storages			2/0/1	PET434
		PET248	Advanced Drilling Fluids			2/0/1	PET432
					10		
1	1211	PET229	Advanced Reservoir Engineering	B	5	2/0/1	PET418
		PET213	Enhanced oil recovery			2/0/1	PET173
		PET226	Principles of Reservoir engineering			2/0/1	PET431
		PET227	Principles of production engineering			2/0/1	PET439
		PET232	Advanced Production Engineering			2/0/1	PET438
	1312	PET230	Advanced Thermodynamics and Phase Behavior of Reservoir Fluids	B	5	2/0/1	PET409
		PET228	Advanced Petrophysics			2/0/1	PHY111

		PET211	Petroleum Reservoir Simulation: Compositional model			2/0/1	MAT103
		PET262	Basic Coding for Petroleum Engineers			2/0/1	CSE677
		PET215	Methods to improve the efficiency of oil and gas pipelines			2/0/1	PET427
	1313	PET216	Petroleum Reservoir Simulation: Black-Oil Model	S		2/0/1	PET420
		PET231	Advanced Gas Engineering			2/0/1	PET420
		PET224	Design of pumping and compressor stations			2/1/0	PET428
		PET206	Applied Well Testing			2/0/1	PET442
		PET 240	Geosteering in drilling		5	2/1/0	PET432
		PET222	Advanced Production Engineering			2/0/1	PET438
		PET236	Advanced well completion			2/0/1	PET426
		PET261	Basic Statistics for Petroleum			2/0/1	PET417
		PET224	Design of pumping and compressor stations			2/0/1	PET428
		PET260	Advanced Rock Mechanics			2/0/1	PET411
		PET242	Well construction and workover supervising			2/1/0	PET421
					15		
2	2314	PET222	Advanced Production Engineering	S	5	2/0/1	PET438
		PET212	Applied well stimulation			2/0/1	PET440
	2315	PET 240	Geosteering in drilling	S	5	2/1/0	PET432
		PET236	Advanced well completion			2/0/1	PET426
	2316	PET260	Advanced Rock Mechanics	S	5	2/0/1	PET411
		PET261	Basic Statistics for Petroleum			2/0/1	PET417
	2317	PET231	Advanced Gas Engineering	S	5	2/0/1	PET420
		PET224	Design of pumping and compressor stations			2/1/0	PET428
		PET206	Applied Well Testing			2/0/1	PET437
	2318	PET216	Petroleum Reservoir Simulation: Black-Oil Model	S	5	2/0/1	PET433
		PET242	Well construction and workover supervising			2/0/1	PET440
		PET215	Methods to improve the efficiency of oil and gas pipelines	B		2/0/1	PET427
			Total		**50**		

OBJECTIVES OF THE EDUCATIONAL PROGRAM PETROLEUM ENGINEERING

1. Our graduates will be successful professionals ready to lead a team, organization, the Republic of Kazakhstan and the world community to new achievements.
2. Our graduates will be able to develop operational plans for all activities related to research, development, design, implementation and management of technological processes and production in the oil and gas sector.
3. Our graduates will be able to formulate and solve problems arising in the course of research and practice.
4. Our graduates will be able to manage complex technological complexes and make decisions in conditions of uncertainty and multi-criteria.
5. Our graduates will be able to assess the prospects and possibilities of using the achievements of scientific and technological progress in the innovative development of the industry, suggest ways to implement them
6. Our graduates will live and practice ethical, social, and environmental standards in their professions in a responsible manner.
7. Our graduates will serve society, the oil and gas industry, and the state through participation in professional communities and public organizations.

Descriptors of the level and amount of knowledge, skills, abilities and competencies

The requirements for the level of preparation of a master's student are determined on the basis of the Dublin descriptors of the second level of higher education (master's degree) and reflect the acquired competencies expressed in the achieved learning outcomes.

Learning outcomes are formulated both at the level of the entire educational program of the master's program, and at the level of individual modules or academic discipline. “The attributes of a graduate form a set of individually assessed learning outcomes, which testify to the potential ability of a student to acquire the competencies necessary to perform professional engineering activities at the proper level. Graduate Attributes serve as an example of the requirements that a graduate of an accredited program must meet. Attributes are characterized by clear statements of expected abilities and if it’s necessary, ranges are provided indicating the required level of achievement of the result, depending on the type of program. "

Descriptors reflect learning outcomes that characterize the student's abilities:

1) demonstrate developing knowledge and understanding in the field of Oil and Gas business, based on the advanced knowledge of the field in the development and / or application of ideas in the context of research;
2) formulate and solve problems arising in the course of scientific research and

practical activities
3) use program-targeted methods for solving scientific problems
4) independently master new research methods, modify them and develop new methods based on the tasks of a specific research
5) use the research methodology in professional activities
6) apply at a professional level their knowledge, understanding and ability to solve problems in a new environment, in a wider interdisciplinary context;
7) collect and interpret information to form judgments, taking into account social, ethical and scientific considerations;
8) communicate clearly and unambiguously information, ideas, conclusions, problems and solutions, both to specialists and non-specialists;
9) learning skills necessary for self-continued further education in the oil and gas segment

Table 2 – Description of Competencies for EP Petroleum Engineering and their relationship with the sectoral qualifications framework for the oil and gas industry (Level 7, Master)

Competencies and their brief descriptions for the EP Petroleum Engineering at K. Satpayev KazNRTU						
Advanced knowledge	**Methodology**	**Teaching**	**Research skills**	**Communication**	**Professionalism**	
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	
By completion of the program, undergraduates and doctoral students will capable of applying advanced knowledge in the field of oil and gas engineering in their professional and academic fields.	By the end of the program, undergraduates and doctoral students will be able to apply appropriate methods analysis like qualitative and quantitative skills, collect and integrate information the best way and according to standards oil and gas industries	By the end of the program, undergraduates and doctoral students will be able to demonstrate teaching skills in the undergraduate program, working with and supervising students	By completion of the program, undergraduates and doctoral students will be able to conduct independent original research, conducive to development oil and gas science and industry, according to the best industry practices and standards.	By the end of the program, undergraduates and doctoral students will capable of communicating and how written and oral, professionally and ethically	By the end of the program, undergraduates and doctoral students will be demonstrate high professional qualities and ethics while interaction with various stakeholders	
Sectoral qualifications framework for oil and gas, refining and petrochemical industries 7-Level (Master)						
Characteristics of knowledge			**Characteristics of skills and abilities**			
(1)	(2)	(3)	(1)	(2)	(3)	(4)
Knowledge at the most advanced level	Evaluation and selection of information	Demonstrate the ability of a strong interest	Research, develop, implement	The most advanced and specialized	Ability to participate verbally or	Ability to generate ideas, predict

in the field of science and professional activities. Use specialized knowledge to critically analyze, evaluate and synthesize new complex ideas that are at the forefront of the field.	necessary for the development of activities. Expand or rethink existing knowledge and / or professional practice within a specific field or at the intersection of fields. Methodological knowledge in the field of innovative and professional activities.	in developing new ideas or processes and a high level of understanding of learning processes.	and adapt projects leading to new knowledge and new solutions.	skills and abilities, including synthesis and assessment, required to solve critical problems in research and / or innovation and to allow for the revision and updating of existing knowledge or professional practice.	in writing in professional discussions and publish research baseline results in international academic journals. Can contribute at the scientific and professional level to the technical, social and cultural progress of society.	the results of innovation activities, implement large-scale changes in the professional and social spheres, manage complex production and scientific processes.

6. Completion Competencies

6.1 Requirements for the key competencies of graduates of the *scientific and pedagogical magistracy*, must:

1) have an idea:

- on the role of science and education in public life;
- about modern trends in the development of scientific knowledge;
- on topical methodological and philosophical problems of natural (social, humanitarian, economic) sciences;
- about the professional competence of a higher school teacher;
- about the contradictions and socio-economic consequences of globalization processes;

2) To know:

- *methodology of scientific knowledge;*
- principles and structure of the organization of scientific activity;
- psychology of students' cognitive activity in the learning process;
- psychological methods and means of increasing the efficiency and quality of education;

3) be able to:

- use the knowledge gained for the original development and application of ideas in the context of scientific research;
- critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena;
- integrate knowledge gained in different disciplines to solve research problems in new unfamiliar conditions;

- by integrating knowledge, make judgments and make decisions based on incomplete or limited information
- to apply knowledge of pedagogy and psychology of higher education in their pedagogical activity;
- apply interactive teaching methods;
- carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;
- to think creatively and be creative in solving new problems and situations;
- be fluent in a foreign language at a professional level, allowing for scientific research and teaching of special disciplines in universities;
- summarize the results of research and analytical work in the form of a dissertation, scientific article, report, analytical note, etc.;

4) have skills:

- research activities, solving standard scientific problems;
- implementation of educational and pedagogical activities on credit technology of education;
- methods of teaching professional disciplines;
- the use of modern information technologies in the educational process;
- professional communication and intercultural communication;
- oratory, correct and logical design of your thoughts in oral and written form;
- expanding and deepening the knowledge necessary for daily professional activities and continuing education in doctoral studies.

5) be competent:

- in the field of research methodology;
- in the field of scientific and scientific-pedagogical activities in higher educational institutions;
- in matters of modern educational technologies;
- in the implementation of scientific projects and research in the professional field;
- in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.

B - *Basic knowledge, abilities and skills*

B1 - use a foreign language to study foreign experience in the mainstream and related fields of science and technology, as well as for business professional communication;

B2 - to understand and analyze the economic, environmental, social and industrial safety problems of the oil and gas industry

B3- reasonably present and defend their point of view;

P - *Professional competencies*:

P2 - formulate and solve problems arising in the course of research and practical

activities;

P3 - plan and conduct analytical, simulation and experimental studies, critically evaluate data and draw conclusions;

P4 - improve the operation methods and equipment maintenance technology;

P5 - to conduct an economic analysis of the costs and effectiveness of technological processes and production

P6 - use the research methodology in professional activities;

P7 - use professional software systems in the field of mathematical modeling of technological processes and objects;

P8 - analyze and systematize scientific and technical information on the research topic, select methods and means for solving the problem, conduct patent research in order to ensure the patent purity of new developments;

P8-develop scientific and technical, project and service documentation, prepare scientific and technical reports, reviews, publications based on the results of the research performed;

O - *Human, social and ethical competences:*

O1 - independently improve and develop your intellectual and general cultural level

O2 - evaluate, on the basis of legal, social and ethical standards, the consequences of their professional activities in the development and implementation of socially significant projects

O3 - independently master new research methods, modify them and develop new methods based on the tasks of a specific research

C - *Special and managerial competencies:*

C1 conduct an economic analysis of the costs and effectiveness of technological processes and production;

C2 - use the basic concepts and categories of production management, organization management systems;

C3 - to develop a feasibility study for innovative solutions in professional activities;

6.2 Requirements for the research work of a master student in a scientific and pedagogical magistracy:

1. corresponds to the profile of the master's educational program, according to which the master's thesis is carried out and defended;
2. relevant and contains scientific novelty and practical significance;
3. is based on modern theoretical, methodological and technological achievements of science and practice;
4. performed using modern scientific research methods;
5. contains research (methodological, practical) sections on the main protected provisions;

6. is based on international best practices in the relevant field of knowledge.

6.3 Requirements for organizing practices:

The educational program of the scientific and pedagogical magistracy includes two types of practices, which are carried out in parallel with theoretical training or in a separate period:

1) pedagogical in the DB cycle - at the university;

2) research in the PD cycle - at the place of the dissertation.

Pedagogical practice is carried out with the aim of developing practical skills in teaching and learning methods. At the same time, undergraduates are involved in conducting classes in a bachelor's degree at the discretion of the university.

The research practice of the undergraduate is carried out with the aim of acquainting with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.

The master's thesis is an independent scientific research that ensures the consolidation of academic culture, methodological concepts and methodological skills in the chosen field of professional activity, and provides:

- an independent formulation of a scientific, research, creative or educational-methodical problem;
- independent analysis of research methods used in solving research problems, scientific analysis and generalization of factual material used in the research process;
- obtaining new results of theoretical, applied or scientific and methodological significance.

7. ECTS Diploma Supplement

The application was developed according to the standards of the European Commission, Council of Europe and UNESCO / CEPES. This document is for academic recognition only and is not an official proof of education. Not valid without a university degree. The purpose of completing the European Supplement is to provide sufficient information about the holder of the diploma, the qualification obtained, the level of this qualification, the content of the study program, the results, the functional purpose of the qualification, as well as information about the national education system. The application model that will be used to translate grades uses the European Credit Transfer or Transfer System (ECTS).

The European Diploma Supplement provides an opportunity to continue education at foreign universities, as well as to confirm national higher education for foreign employers. When going abroad for professional recognition, additional legalization of the educational diploma is required. The European Diploma Supplement is completed in English upon individual request and is issued free of charge.

LNG210- Foreign language (professional)

CREDIT - 3 (0/0/3)
PREREQUISIT - Business English, Academic English, IELTS 5.0-5.5

AIM AND OBJECTIVES OF THE COURSE

Thanks to this, the course students will master specific terminology, be able to read specialized literature, acquire the knowledge necessary to implement effective oral and written communications in a foreign language in their professional activities.

BRIEF DESCRIPTION OF THE COURSE

In the process of training, students acquire knowledge of a foreign language, including proficiency in specialized vocabulary, necessary for the implementation of effective oral and written communications in a foreign language in their professional activities. Practical tasks and methods for developing the required language skills in the learning process include: case method and role-playing games, dialogues, discussions, presentations, listening tasks, working in pairs or in groups, completing various written tasks, grammar tasks and explanations.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
expand professional vocabulary	✓	✓				
possess the skills of effective communication in a professional environment			✓		✓	
express thoughts correctly in oral and written speech, understand specific terminology			✓		✓	
read specialized literature.						

critically analyze information, abstract and annotate texts;		✓				

HUM210 - History and Philosophy of Science
CREDIT - 2 (1/0/1)
PREREQUISIT - HUM124

AIM AND OBJECTIVES OF THE COURSE

To reveal the connection between philosophy and science, to highlight the philosophical problems of science and scientific knowledge, the main stages of the history of science, the leading concepts of the philosophy of science, modern problems of the development of scientific and technical reality

BRIEF DESCRIPTION OF THE COURSE

The subject of philosophy of science, dynamics of science, specificity of science, science and pre-science, antiquity and the formation of theoretical science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, technology and technology, specificity of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
know and understand the philosophical issues of science, the main historical stages of the development of science, the leading concepts of the philosophy of science,	✓	✓				
be able to critically assess and analyze scientific and philosophical problems,			✓		✓	
understand the specifics of engineering science, possess the skills of analytical thinking and philosophical reflection,		✓				

be able to substantiate and defend their position, master the techniques of discussion and dialogue,		✓	✓			
possess the skills of communication and creativity in their professional activities		✓			✓	

HUM209- Higher education pedagogy
CREDIT - 2 (1/0/1)
PREREQUISIT - LNG102

AIM AND OBJECTIVES OF THE COURSE

the course is aimed at studying the pedagogical essence of the educational process of higher education; formation of ideas about the main trends in the development of higher education at the present stage, consideration of the methodological foundations of the learning process in higher education, as well as psychological mechanisms affecting the success of learning, interaction, management of subjects of the educational process. Development of pedagogical thinking of undergraduates.

BRIEF DESCRIPTION OF THE COURSE

In the course of studying the course, undergraduates get acquainted with the didactics of higher education, the forms and methods of organizing education in higher education, the mechanisms of educational influence, pedagogical technologies, characteristics of pedagogical communication, and mechanisms for managing the learning process. Analyze organizational conflicts and ways to resolve them, psychological destruction and deformation of the teacher's personality.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
know the features of the modern system of higher professional education,	✓	✓				
know the organization of pedagogical research,	✓		✓		✓	
know the characteristics of the subjects of the educational process,	✓	✓				

know the didactic basics of organizing the learning process in higher education	✓	✓	✓			
know pedagogical technologies	✓	✓			✓	
know the patterns of pedagogical communication	✓	✓			✓	
know the features of educational influences on students, as well as the problems of pedagogical activity	✓	✓			✓	

HUM208 - Psychology of management
CREDIT - 2 (1/0/1)
PREREQUISIT – no

AIM AND OBJECTIVES OF THE COURSE

formation of students' understanding of the role and multidimensional content of the psychological component of management activities; the formation of a psychological culture of management activities; independently finding the best ways to achieve goals and overcoming difficulties in interpersonal relationships; increasing the psychological culture of the future master for the successful implementation of professional activities and self-improvement; understanding the psychological factors that influence management decision making.

BRIEF DESCRIPTION OF THE COURSE

The course is designed to provide balanced coverage of all the key elements that make up the discipline. It will briefly review the origins and development of the theory and practice of organizational behavior, followed by a review of the main roles, skills and functions of management with a focus on management effectiveness, illustrated with real-life examples and case studies.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
know the basic mechanisms and styles of management, functions and processes of management, theory	✓	✓				

leadership and motivation						
determine the role of the leader in relations with team members	✓		✓		✓	
to formulate the goals, objectives of the organization, the participation of personnel in their implementation	✓	✓				
predict, plan, organize and coordinate, control your activities in the staff	✓	✓	✓			
navigate the processes of changing values and value orientations	✓	✓			✓	
identify general patterns of human behavior in a modern organization	✓	✓			✓	
form an individual leadership style	✓	✓			✓	
use ready-made psychodiagnostic methods;	✓	✓			✓	
develop and carry out psychometric support of ready-made techniques;	✓	✓			✓	
interpret the results of the performed psychodiagnostic examination	✓	✓			✓	

PET 266 - Theory of motion of gas-liquid mixtures
CREDIT - 2 (1/0/1)
Prerequisite - Technology and Equipment of Oil Production

AIM AND OBJECTIVES OF THE COURSE

Study of the physics of the process of movement of a gas-liquid mixture in a vertical pipe, the structures and forms of gas-liquid flows, the operation of elevators, methods for calculating the distribution of pressure and temperature in the elevator.

BRIEF DESCRIPTION OF THE COURSE

Distinctive features of gas-liquid mixtures, determination of the density of a gas-liquid mixture, the structure and forms of movement of gas-liquid mixtures, criteria for identifying structures and forms of gas-liquid flows, energy balance in a well, operation of ideal and semi-ideal lifters, lifter operation in various modes.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	Completion Competencies					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
to identify the distinctive features of gas-liquid mixtures;	✓	✓				
explain the model of constrained movement of gas bubbles in a stationary liquid;			✓		✓	
determine the density of the gas-liquid mixture;		✓			✓	
calculate the properties of oil in the process of its single degassing;		✓	✓		✓	
calculate the distribution of pressure and temperature along the depth of the production well;		✓			✓	
analyze the equation of motion of the mixture in an elementary hoist and the equation of motion for the mixture in long hoists.		✓				

PET263 - Oil and Gas Engineering Seminar
CREDIT - 3 (1/0/2)
PREREQUISIT – no

AIM AND OBJECTIVES OF THE COURSE

The development of students' general skills and abilities necessary in research search, writing research papers, as well as public speaking.

BRIEF DESCRIPTION OF THE COURSE

Scientific study as the main form of scientific work. General methodology of scientific creativity. Application of logical laws and rules. Preparation for writing a scientific work and the accumulation of scientific information. The structure and preparation of a scientific article. Preparation of presentation for defense. Public speaking skills. Informativeness of the speech.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	Completion Competencies

Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Solve standard tasks of professional activity based on information and bibliographic culture using information and communication technologies and taking into account the basic requirements of information security	✓	✓		✓		
Carry out the formulation of professional tasks in the field of research and practical activities		✓		✓		
Present the results of analytical and research work in the form of a speech, report, information review, analytical report, article		✓		✓	✓	
Know the methods of planning, conducting, and processing the results of experimental research		✓		✓		
Be able to work in software packages for planning and processing the results of an experiment, using methods of mathematical modeling in scientific research;	✓			✓		

PET 226 - Principles for the development of oil and gas fields
CREDIT - 3 (2/0/1)
PREREQUISIT - Oil and Gas Development II: Secondary and Tertiary Production Techniques

AIM AND OBJECTIVES OF THE COURSE

- to reveal the basic concepts underlying the development of oil and gas fields;
- to demonstrate the derivation of the basic differential equation of radial filtration, the equation of quasi-steady and steady-state inflows into the well;
- to generalize the solutions of the piezoconductivity equation for use in well survey;
- to reveal the concept of water inflow into the reservoir;
- demonstrate calculations for predicting the production of oil and gas fields;
- to acquaint with the basics of immiscible displacement, to compare possible scenarios of immiscible displacement.

Course objectives:

As a result of studying the discipline, the student must know:

- basic concepts of oil field development;
- equation of radial filtration, quasi-steady and steady-state inflow, equation of piezoconductivity;

- fundamentals of hydrodynamic well testing;
- equations and theories of water inflow into the reservoir;
- equations and theories of immiscible displacement;

BRIEF DESCRIPTION OF THE COURSE

The basic concepts behind the development of oil and gas fields. Phase states of hydrocarbons. Analysis of PVT properties of reservoir fluids. Properties of reservoir rocks. Darcy's law and its application.

Calculation of initial hydrocarbon reserves. Change in pressure and temperature in the reservoir with depth. Natural regimes of oil displacement. Material balance concept for gas and gas condensate deposits. Material balance of saturated and unsaturated oils, Basic differential equation of single-phase flow in a porous medium. Equations of quasi-steady and steady-state inflows into the well. Basic differential equation of single-phase flow in a porous medium. Equations of unsteady inflow into the well

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Determine PVT properties of formation fluids and rocks and perform filtration calculations in porous media	✓	✓				
Predict reservoir pressure and production of oil and gas wells, determine well parameters based on hydrodynamic testing data			✓		✓	
Calculate the flow of water into the reservoir, predict oil production during waterflooding		✓				
Transform the material balance equation for different modes of reservoir operation and estimate reserves and production rates		✓	✓			
Apply methods of designing the development of oil fields using traditional technology and methods of enhanced oil recovery		✓			✓	

Analyze and regulate the development of oil and gas fields, understand the processes occurring in the well and in the bottomhole formation zone and assess the prospects for the development and improvement of known processes	✓				✓	
Conduct experiments on your own, present and argue your opinion			✓	✓		
Prepare an article for publication				✓		

PET 227 - Principles of oil production technologies
CREDIT - 3 (2/0/1)
PREREQUISIT - Technology and technique of oil production

AIM AND OBJECTIVES OF THE COURSE

Objectives of the course. Identify the principal sources of reservoir energy; calculate the physical properties of reservoir oils and reservoir waters; carry out the selection of technologies for influencing the oil reservoir and the bottomhole zone of the well; calculate starting pressure for homogeneous and double row gas lift hoists; calculate the gas separation factor at the pump intake and the filling factor of the downhole pump; calculate the stresses in the rods; to determine the depth of pumping down.
Competencies that undergraduates will possess at the end of the course: in processing the results of well testing by methods of steady and unsteady production; in the analysis of the conditions of joint operation of the well and the formation; in determining the depth of installation of starting valves in a gas-lift well; in identifying the loads acting on the rod string; in bringing wells to the technological mode of operation.

BRIEF DESCRIPTION OF THE COURSE

Principles of opening productive objects, principles of inflow induction and well development, principles of influencing a productive formation, principles of influencing the bottomhole zone of a well, principles of well operation, principles of calculating the operating modes of the “well-reservoir” system.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Identify the principal sources of reservoir energy	✓	✓				
Calculate the physical properties of reservoir oils and reservoir waters	✓	✓				

Select technologies for influencing oil accumulation and to the bottomhole zone of the well	✓	✓				
Calculate Starting Pressure for Homogeneous and Single Row Gas Lift	✓	✓				
Calculate the gas separation factor at the pump intake and the filling factor of the downhole pump				✓		
Calculate the stresses in the rods				✓		✓
Determine pump lowering depths				✓		✓
Processing of well survey results using steady and unsteady production methods				✓		✓
Analysis of conditions for joint operation of the well and the formation				✓		✓

PET 213 - Enhanced Oil Recovery Techniques
CREDIT - 3 (2/0/1)
PREREQUISIT - Field Development II, III, Principles of Oil Production Technologies, Well Testing and Interpretation

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AIM AND OBJECTIVES OF THE COURSE

- to determine the physical foundations of enhanced oil recovery methods,
- explore ways to improve the efficiency of oil recovery.
- to describe a complex of methods for enhancing oil recovery for the development of oil fields.
- to investigate the physical, colloidal-chemical and rheological properties of oils.
- to analyze the processes occurring in the well and in the bottomhole formation zone and to assess the prospects for the development and improvement of known processes, as well as to highlight the principal directions for the development of new technologies with the solution of issues of their technical support.
- to analyze existing technologies, experimental studies of interphase properties and processes of interaction of reagents with reservoirs, as well as processes of oil displacement.
- demonstrate calculations for predicting the production of oil and gas fields; understand the basics of the influence of the physical, physical and mechanical, thermal, physicochemical and molecular-surface properties of reservoir rocks and fluids (oil, gas, water) in them on oil recovery.
- to determine the properties of reservoir rocks and fluids (oil, gas, water) and process the obtained experimental data, establish the patterns of their change.
- to assess the ability to control the properties of reservoir rocks and fluids in them to enhance oil recovery.

- to choose effective methods and means of controlling the properties of reservoir rocks and fluids to increase oil and gas recovery of reservoirs.

BRIEF DESCRIPTION OF THE COURSE

Existing classifications of enhanced oil recovery methods. Steam treatment of the bottomhole zone of wells. Displacement of oil from the reservoir by polymer solutions. Displacement and additional displacement of oil with alkali solutions. Impact on the reservoir with high pressure gases. Thermal methods of enhanced oil recovery. In-situ combustion. Oil recovery of reservoirs under various conditions of reservoir drainage. A qualitative criterion in assessing the effectiveness of enhanced oil recovery methods. The role of enhanced oil recovery methods in the late stage of field development. Investigation by optical methods of the composition and properties of residual oils formed in the course of field development. Application of a method based on artificial intelligence (AI) to select an object and technology for enhanced oil recovery. Well completion calculation (direct and reverse injection). Creation of microbiological methods of bottomhole treatment of production wells. Development of a calculation scheme for modeling the processes of microbiological impact in the conditions of heterogeneous formations. Horizontal wells. The choice of methods for analyzing the technological efficiency of the EOR application. Applicability criteria and evaluation of the results of using EOR and HMO at a late stage

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Understand the processes occurring in the well and in the bottomhole formation zone and assess the prospects for the development and improvement of known processes, as well as highlight the principal directions for the development of new technologies with the solution of issues of their technical support. Calculate and describe a set of methods for enhancing oil recovery.	✓	✓	✓			✓
Predict reservoir pressure and production of oil and gas wells, determine well parameters based on hydrodynamic testing data			✓		✓	
Calculate the flow of water into the reservoir, predict oil production during waterflooding	✓	✓			✓	
Be able to investigate the physical, colloidal-chemical and rheological properties of oils.			✓	✓		✓
Apply methods of designing the development of oil fields using traditional technology and methods of enhanced oil recovery			✓	✓		✓

To study the analysis of existing technologies, experimental studies of interphase properties and processes of interaction of reagents with reservoirs, as well as processes of oil displacement.	✓				✓	
Experiment on your own present and argue your opinion				✓	✓	✓
Prepare an article for publication				✓		✓

PET 248 - Advanced Drilling Fluids
CREDIT - 3 (2/0/1)

PREREQUISIT - Drilling fluids and grouting mixtures

AIM AND OBJECTIVES OF THE COURSE

Purpose: To study the principles and methods of the scientific basis for managing the properties of drilling fluids. Objectives of the course: to acquaint with the corresponding equipment, instruments and methods for monitoring the indicator of the properties of drilling fluids, the principles of choosing the target criterion when regulating the technological properties of the drilling fluid, the principles of controlling the structural-mechanical and filtration properties of the drilling fluid under the influence of various factors, with the relationship of the processing of the drilling fluid with solution of the hydraulic drilling program.

BRIEF DESCRIPTION OF THE COURSE

This course includes topics such as the influence of the quality of drilling fluids and the well flushing mode on the efficiency of drilling technology, structure formation and deformation of drilling fluids, equipment and methods for measuring the structural and mechanical properties of drilling fluids, filtration of drilling fluids, indicators of properties and flow regimes of drilling fluids, patterns changes in the structural, mechanical and filtration properties of the drilling fluid, types of drilling fluid and materials for regulation, formulation and control of the properties of drilling fluids.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Know the operating conditions of drilling fluids in the well	✓					
Know and apply the technique of measuring the properties of drilling fluids	✓		✓			

Measure the structural and mechanical properties of drilling fluids		✓				
Investigate the structural and mechanical properties of drilling fluids with temperature changes			✓	✓		
Interpret the results of the obtained experimental data when studying the properties of the drilling mud				✓		
Draw up a hydraulic well flushing program		✓	✓			
Select the type of drilling fluid for different drilling conditions	✓					
Develop and improve drilling fluids for various drilling conditions		✓		✓		
Know the principles of choosing a recipe with specified properties	✓					
Know and apply experimental design and analysis techniques to formulate drilling mud		✓		✓		
Determine and calculate the recipe composition of the drilling fluid	✓	✓				

PET212 - Applied well stimulation
CREDIT - 3 (2/0/1)
PREREQUISIT - Oil and Gas Development II: Secondary and Tertiary Production Techniques

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AIM AND OBJECTIVES OF THE COURSE

Study and analysis of modern methods of stimulation of formation fluid inflow. Analysis and generalization of data for specific fields. consideration of the dependence of intensification on production indicators.

BRIEF DESCRIPTION OF THE COURSE

Reservoir stimulation methods; acid treatment. preliminary tests; acidizing equipment; processing techniques; step acid treatment; Acid treatment additives. Inhibitors; Activating additives; Surfactants; Demulsifiers; Silicate control; Hot acid; Delayed acid; Iron retention; Acid for removing drilling mud; Cleaning solutions; Anhydrous acid; Hydraulic fracturing. Cracks and their structure; Fracturing equipment; Hydraulic fracturing technology; Fracturing materials; Other methods of reservoir stimulation. Torpedoing; Explosion of a linear charge; Re-perforation; Glass beads; Abrasive blasting; Removal of paraffin; Large-scale injection treatment; Enhanced oil recovery. Waterflooding; Reservoir geometry; Lithology; Collector depth; Porosity; Permeability; Uniform strata of reservoir rocks; The magnitude and distribution of fluid saturation;

Fluid properties and related permeability ratios; Sources of water; Well location during waterflooding; Water preparation; Residual oil after waterflooding; Tertiary production methods, or enhanced oil recovery; Injection of chemical solutions into the formation; Injection of oil-miscible fluids; Thermal methods.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Know the main methods of well stimulation			✓			
Analyze the advantages and disadvantages of various methods of enhanced oil recovery			✓		✓	
Perform hydraulic fracturing calculations						
Carry out calculations for hydrochloric acid treatment			✓			
Explain the dependence of intensification on production rates.						
Analyze production stimulation data by field	✓				✓	
Justify the choice of reservoir stimulation methods		✓	✓			

PET215 - Methods to improve the efficiency of gas and oil pipelines
CREDIT - 3 (2/0/1)
Prerequisite - Design and operation of oil and gas pipelines

AIM AND OBJECTIVES OF THE COURSE

To acquaint future specialists with methods of increasing the efficiency of gas and oil pipelines.

BRIEF DESCRIPTION OF THE COURSE

During the course of the discipline, undergraduates get acquainted with methods of increasing the efficiency of gas and oil pipelines, such as correct hydraulic calculation when using gas and oil pipelines, cleaning the internal cavity of the pipeline, calculating the bearing capacity of a gas and oil pipeline. The discipline considers the main issues of pipeline transportation of liquid and gaseous hydrocarbons, provides a classification of pipelines and its main objects, the essence of technological processes associated with pumping oil and gas through main pipelines, as well as the sequence of technological calculations of main pipelines. improving the efficiency of gas and oil pipelines, such as correct hydraulic calculation when using gas and oil pipelines, cleaning the internal

cavity of the pipeline, calculating the bearing capacity of the gas and oil pipeline.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Know the classification and purpose of pipelines	✓	✓				✓
Perform calculations to determine the wall thickness of pipelines.	✓	✓				
Develop a plan for quality control of the construction of main pipelines				✓		
To predict and optimize the performance of pipeline with the use of modelling and assessment uncertainty.			✓			
Evaluate the condition of the internal cavity and pipeline junctions						
Apply knowledge, modern methods and software design tools for the preparation of design and operational and technological documentation of objects of collection, preparation, transport and storage of oil and gas	✓					
Basic approaches to the design of field and main pipeline systems, main and auxiliary equipment	✓			✓		
Perform simple hydraulic calculations and other calculations of pipelines with the use of specialized modern technology	✓					

PET 232 – Advanced Economic Analysis of Oil and Gas Projects
CREDIT – 3 (2/0/1)
PREREQUISITES – **Principles of production engineering**

AIM AND OBJECTIVES OF THE COURSE

The main goal of the course is the technique and technology of well construction in complicated conditions, technique and technology of oil production in complicated conditions, scientific understanding of technological processes and works in oil production in complicated conditions.
Objectives of the course. Conduct selection of modern technologies of impact on the oil Deposit and on the bottom-hole zone of the well in complicated conditions; technologies of oil production from a horizontal well; advanced Analytics;

commissioning of advanced oil production technologies and modern practices; automation of oil wells, nanotechnology in oil production; Office applications (Word, Excel, PowerPoint, etc.) advanced level.

BRIEF DESCRIPTION OF THE COURSE

Modern technology of producing objects in the complicated conditions of modern technology inflow and development wells, modern technologies impact on the producing formation, modern technology impact on bottom-hole zone of the well, wells automation, automation modes of the system "well–layer".

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
To identify the current impact of technology on the oil reservoir	✓	✓				
Identify modern technologies of impact on the bottom-hole zone of the well	✓	✓				
To carry out the selection of modern technology impacts on the oil Deposit and on the bottom-hole zone of the well	✓	✓				
Perform technological calculations of oil production from a horizontal well	✓	✓				
Introduction of advanced oil production technologies and modern practices				✓		
Automation of oil wells				✓		✓
Nanotechnologies in oil production				✓		✓
Office applications (Word, Excel, PowerPoint, etc.) advanced level.				✓		✓
Analysis of the conditions of joint operation of the well and the formation, the output of wells to the technological mode of operation				✓		✓

PET 206 – Applied well testing

CREDIT – 3 (2/0/1)

PREREQUISITE - Geophysical studies of reservoir parameters

AIM AND OBJECTIVES OF THE COURSE

The purpose of teaching the discipline is to form students ' knowledge of the basic

principles of well exploration, as well as the application of this knowledge in solving various problems. This course is designed to improve students ' self-study skills. Therefore, students should consciously allocate enough time and energy to read, understand, and apply knowledge and skills in the classroom. Lectures will be held in the form of a discussion based on what students have learned and missed while working on tasks.

BRIEF DESCRIPTION OF THE COURSE

This course includes the practical application of the basic theory of well testing to the development and interpretation of well testingdata. An integrated approach to interpreting well data will be considered throughout the course. Synthetic data sets and examples from real wells will be illustrated and interpreted based on the Kappa software.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Understand the physical nature of the processes occurring in the formation during the movement of reservoir fluids	✓	✓	✓	✓	✓	✓
Understand the basics of well hydrodynamic research	✓	✓	✓	✓	✓	✓
Interpret data from hydrodynamic studies of oil and gas wells using traditional and modern methods of analysis	✓	✓	✓	✓	✓	✓
Distinguish between the tasks of hydrodynamic research and select the types of research to solve these problems	✓	✓	✓	✓	✓	✓
To apply the test wells with varying pressures to characterize well and reservoir, that is, the skin, the permeability, distances to the boundaries to apply the test wells with a variable flow rate to characterize well and reservoir, that is, skin, permeability, net sand volume	✓	✓	✓	✓	✓	✓

PET222 - Advanced Production Engineering
CREDIT – 3 (2/0/1)
PREREQUISITE – Technique and technology of oil and gas production

AIM AND OBJECTIVES OF THE COURSE

The main goal of the course is to promote the development of scientific and technical thinking and the acquisition by students of the necessary knowledge and practical skills in the field of oil well operation for the optimization of oil production processes. Course objectives: 1) to Study the main directions of the solution and to master the solution of problems on assessment of productivity of wells, the choice of a method of operation and the required equipment for its implementation. 2) Master the skills of analyzing the operation of downhole equipment and adjusting its operating mode in order to improve the efficiency of wells. 3) Develop skills in developing measures to increase the inter-repair period of well operation and the average time to failure of downhole equipment.

BRIEF DESCRIPTION OF THE COURSE

The course will cover the principle and application of the various theories and techniques required to design, evaluate and maximize production efficiency in a cost-effective manner. Attempts will be made to understand how these methods can be applied in a practical field development project to determine the best way to use oil reserves, as well as to maximize final production. This course will focus on the details of reservoir inflow performance, well performance, gas lift system design, familiarization with oil and gas facilities, and analysis and optimization of all oil production systems using conventional and nodal analysis.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Conditions for the effective use of various borehole pumping units			✓	✓		
The main production processes that represent a single chain of oil and gas technologies.			✓		✓	
The main economic indicators that characterize the efficiency of production processes for the development of hydrocarbon deposits.		✓				
To work in software products for simulation of the development process at the level of "advanced user»			✓		✓	
Organize analyze and use baseline information for calculation of the indicators of the processes of development of oil deposits		✓				
To calculate the basic technological parameters	✓	✓				
To apply the calculation methods of technological parameters of development using modern software			✓	✓		

Analyze and justify the decisions taken to improve the technological and economic efficiency of the process of extracting hydrocarbons from deposits				✓		
Skills analysis and evaluation of the efficiency of operation of oilfield equipment			✓		✓	
Analyze the causes of failures of deep-pump equipment and plan measures to increase the operating time for failure of downhole equipment.		✓				

PET230 - Advanced level of thermodynamics and phase States of reservoir fluids
CREDIT – 3 (2/0/1)
PREREQUISITE-Principles of oil and gas field development

AIM AND OBJECTIVES OF THE COURSE

Obtaining knowledge by undergraduates and doctoral students on the basics of advanced thermodynamic processes and phase States of reservoir fluids and the possibility of using this knowledge in solving problems and problems of oil and gas field development.

BRIEF DESCRIPTION OF THE COURSE

Introduction. Objectives of the course "Advanced level of thermodynamics and phase States of reservoir fluids" Laws of thermodynamics in technological processes of oil and gas production. Thermophysical properties of sedimentary rocks. Thermophysical properties of reservoir fluids of natural origin. Components of reservoir fluids. Equations of state. Phase state of reservoir fluids. Phase change: PT diagrams - single-component system; PT diagram-multi-component systems. Theory of phase transitions. Compressibility of rock and reservoir fluids. Thermal power plants in the oil and gas industry. Heating furnaces for oil. Of the combustion device. The burning of the fuel. Steam installations in the oil and gas industry. Heat balance of the boiler unit. Thermal effects on oil reservoirs and the bottom-hole zone of wells Thermal processes in the preparation of oil and gas. Environmental issues in the use of heat.
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KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	Completion Competencies					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
The ability to study and analyze the necessary information, technical data, indicators and results of work to improve the technological processes of development and operation of oil and gas fields.		✓	✓			
Ability to study and analyze the necessary information, technical data, indicators and results of work on improving heat and power equipment, units, systems and elements.	✓		✓		✓	
Skills in performing technical calculations of thermal and physical effects on oil reservoirs and processing the bottom-hole zone of oil and gas wells	✓				✓	
Skills in performing calculations of thermal installations and organizing computational experiments in the field of professional activity	✓		✓			
Skills of conducting laboratory and experimental - industrial experiments in the field of professional activity.						✓
Ability to evaluate research results with basic knowledge, mathematical apparatus and methods in the field of energy-saving equipment design.	✓				✓	
Ability to evaluate research results with basic knowledge, mathematical apparatus and methods in the field of design of secondary energy resource utilization systems.		✓	✓			✓

PET228 - Advanced Petrophysics

CREDIT – 3 (2/0/1)

PREREQUISITE – **Rock properties**

AIM AND OBJECTIVES OF THE COURSE

- in-depth study of rock properties for a better understanding of reservoir operation
- conducting research to measure the properties of rocks
- practical application of petrophysical data for use in the development of oil and gas reservoirs

BRIEF DESCRIPTION OF THE COURSE

The course involves a more detailed study of Mineralogy, porosity, permeability, capillary pressure, wettability, surface tension, as well as the interaction of these

parameters. During this course, each petrophysical parameter is studied not only from a theoretical point of view, but also the practical side of its application and measurement is fixed by appropriate calculations and laboratory studies.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
To describe visually describe the rock samples	✓	✓	✓	✓	✓	✓
Perform measurements of petrophysical parameters on laboratory installations	✓	✓	✓	✓	✓	✓
Interpret petrophysical data obtained in the course of the measurements	✓	✓	✓	✓	✓	✓
Check by calculation of petrophysical data obtained in the course of the measurements	✓	✓	✓	✓	✓	✓
Analyze the relationship between porosity and permeability parameters	✓	✓	✓	✓	✓	✓
Integrate petrophysical data into a hydrodynamic model	✓	✓	✓	✓	✓	✓
Compare petrophysical and geophysical data	✓	✓	✓	✓	✓	✓

PET229 - Advanced Reservoir Engineering

CREDIT – 3 (2/0/1)
PREREQUISITE – **PHY111**

AIM AND OBJECTIVES OF THE COURSE

The purpose of the discipline is to:
- in-depth study of the properties of reservoir fluids, relative permeability, and the effect of plantar water on oil and gas production
- practical application of methods for maintaining reservoir pressure, methods for increasing oil recovery, as well as other techniques for optimizing the operation of the reservoir

BRIEF DESCRIPTION OF THE COURSE

An in-depth overview and understanding of practical tools for analyzing the operation of an oil or gas reservoir. The course includes a set of basic calculations for determining the reserves of gas and oil in the reservoir, studying the history of production to predict the flow rates of oil, gas and water. Modeling of various options for field development.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	Completion Competencies					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Build hydrodynamic models of various development options using methods of maintaining reservoir pressure and methods of increasing oil recovery	✓	✓	✓	✓	✓	✓
Interpret geophysical data	✓	✓	✓	✓	✓	✓
To select methods of increasing oil recovery for the conditions of a particular field	✓	✓	✓	✓	✓	✓
Manage the process of flooding the field	✓	✓	✓	✓	✓	✓
Interpret the results of hydrodynamic studies	✓	✓	✓	✓	✓	✓
Check the accuracy of incoming data from the field	✓	✓	✓	✓	✓	✓
Build mathematical models of methods for increasing oil recovery	✓	✓	✓	✓	✓	✓

PET230 – Advanced Thermodynamics and Phase Behavior of Reservoir Fluids

CREDIT – 3 (2/0/1)

PREREQUISITE – **Thermodynamics and heat engineering**

AIM AND OBJECTIVES OF THE COURSE

Obtaining knowledge by undergraduates and doctoral students on the basics of advanced thermodynamic processes and phase States of reservoir fluids and the possibility of using this knowledge in solving problems and problems of oil and gas field development.

BRIEF DESCRIPTION OF THE COURSE

Introduction. Objectives of the course "Advanced level of thermodynamics and phase States of reservoir fluids" Laws of thermodynamics in technological processes of oil and gas production. Thermophysical properties of sedimentary rocks. Thermophysical properties of reservoir fluids of natural origin. Components of reservoir fluids. Equations of state. Phase state of reservoir fluids. Phase change: PT diagrams - single-component system; PT diagram-multi-component systems. Theory of phase transitions. Compressibility of rock and reservoir fluids. Thermal power plants in the oil and gas industry. Heating furnaces for oil. Of the combustion device. The burning of the fuel. Steam installations in the oil and gas industry. Heat balance of the boiler unit. Thermal effects on oil reservoirs and bottom-hole zone of wells processes in the preparation of oil and gas. Environmental issues in the use of heat.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	Completion Competencies					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
study and analyze the necessary information, technical data, indicators and results of work to improve the technological processes of development and operation of oil and gas fields		✓	✓			
study and analyze the necessary information, technical data, indicators and results of work on improving heat and power equipment, units, systems and elements.	✓		✓		✓	

PET231 – Advanced Gas Engineering

CREDIT – 3 (2/0/1)

PREREQUISITE – **Natural gas engineering**

AIM AND OBJECTIVES OF THE COURSE

The purpose of the discipline is to familiarize undergraduates with current technological trends in the development and production of gas, the formation of skills related to research and production activities in the field of operation of oil and gas wells under the influence of complicating factors

BRIEF DESCRIPTION OF THE COURSE

Students will get acquainted with modern methods of determining gas properties, features of operation of gas wells, technological parameters of gas movement from the reservoir to the consumer, methods of creating and operating underground gas storage facilities**.**

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	Completion Competencies					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
By the end of the program, undergraduates will be able to demonstrate skills in processing the results of gas well research	✓	✓	✓	✓	✓	✓
By the end of the program, undergraduates will be able to demonstrate skills in calculating the parameters of technological development processes in oil and gas production.	✓	✓	✓	✓	✓	✓

Calculate the design of the development of gas deposits, calculate the main parameters of well operation	✓	✓	✓	✓	✓	✓
Choose the method of impact on the bottom-hole zone of wells, make the selection of equipment and pipelines in the process of collecting and preparing well products.	✓	✓	✓	✓	✓	✓
Analyze problems and look for ways to effectively solve them in various gas field development options. Analyze and justify the decisions taken to improve the technological and economic efficiency of the process of extracting hydrocarbons from deposits.	✓	✓	✓	✓	✓	✓
Conduct independent original research that contributes to the development of oil and gas science and industry, according to the best practices and standards of the industry. Create new technologies for gas production under low reservoir pressures, influencing the productive formation to increase the gas recovery coefficient.	✓	✓	✓	✓	✓	✓
Solve the problems of complications arising in the development of gas fields)	✓	✓	✓	✓	✓	✓
To develop methods, technical means and technologies for the development of hard-to-recover and unconventional gas resources in low-pressure reservoirs, gas hydrate deposits and methane in coal basins	✓	✓	✓	✓	✓	✓

PET246 – Principles of drilling technology

CREDIT – 5 (2/1/0/2)

PREREQUISITE – **Oil and gas well drilling**

AIM AND OBJECTIVES OF THE COURSE

Teaching students the basics of well construction technology, well design, scienti understanding of the main technological processes and operations in oil production. T acquired knowledge contributes to the formation of the master's skills in drilling and oil and g wells.

BRIEF DESCRIPTION OF THE COURSE

The discipline describes modern methods of drilling oil and gas wells, drilling methods, w design, choice of drilling scheme and calculation of the influence of parameters on the drilli method and the influence of drilling fluid on the bit operation, as well as their impact on t operating costs of drilling 1 meter. Students will also learn about the difficulties and proble in drilling and methods of their elimination, about inclined drilling, about offshore drilling a platform design, about technical and economic indicators during drilling, methods of lab

safety and the environment.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
✓ Design and evaluate the drilling system, identify problems and propose solutions for the geometry of wells, including directional and horizontal wells	✓	✓	✓	✓	✓	✓
Calculate the pressure from the pump to the bit at each stage of drilling operations based on rheological models and drilling hydraulics according to API standards.	✓	✓	✓	✓	✓	✓
Make a casing design, taking into account the pore pressure and the rock fracture gradient	✓	✓	✓	✓	✓	✓
Establish a proper well control procedure to ensure the safety of personnel and protect the environment	✓	✓	✓	✓	✓	✓
Make a design of a proper well cementing procedure, taking into account environmental and legal issues	✓	✓	✓	✓	✓	✓

PET247 – Principles of designing oil and gas storages

CREDIT – 3 (2/0/1)
PREREQUISITE - **Design and operation of oil and gas storages**

AIM AND OBJECTIVES OF THE COURSE

The purpose of studying the discipline is to acquire students ' skills in calculating oil depots and equipment, reliability and efficiency of operation of all gas and oil storage facilities, development and implementation of measures to reduce oil losses.

BRIEF DESCRIPTION OF THE COURSE

Underground and surface reservoirs. The Foundation and the base of the tanks. When choosing sites for placing reservoirs, the following factors are taken into account: the quality and condition of the soil lying at the base of the site; climatic and seismic conditions of the area; the flow regime of groundwater, its chemical composition, as well as the permissible loads on the soil and the type of base that must be determined for each case after a thorough analysis. The classification of the tank farms. The main structures of oil depots. Nomenclature of domestic steel tanks. Technical characteristics of tanks Vertical isothermal tanks. Axisymmetric teardrop-shaped tanks. Horizontal tanks. Technical and economic indicators. Losses of oil and petroleum products during the

operation of tank farms. General procedure for the repair of tanks at oil depots. Determination of the volume of the tank farm and selection of tank types.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Explain the conditions and modes of operation and gas and oil storage facilities used for the construction of objects of oil and gas production and processing industry of steel and other building materials, as well as the main methods of calculation and design in accordance with the existing regulatory documentation					✓	
Calculate the capacity of the tank farm of the tank farm, losses when filling transport tanks, select and apply various pipeline construction materials depending on the operating loads and operating conditions of equipment and structures	✓				✓	
Recommend a method for hydraulic calculations of hydrodynamic systems				✓		✓
Use economic parameters to justify the effectiveness of proposed projects and technological solutions			✓			
Choose rational modes of operation of gas and oil storage facilities				✓	✓	
Basic calculations and materials required for the design of gas and oil storage facilities	✓		✓			
To assess the regulatory, technical and legislative base of design systems and organizations for the construction of gas and oil pipelines and gas and oil storage facilities and the tasks of forecasting their technical condition.			✓			

PET236 – Advanced well completion

CREDIT – 3 (2/0/1)

PREREQUISITE – **Well drilling**

AIM AND OBJECTIVES OF THE COURSE

The main purpose of the course is to promote the development of scientific and technical thinking and the acquisition by students of the necessary knowledge and practical skills in the field of drilling and well completion. Objectives of the course: Students should acquire the skills of competent selection of the method of opening productive objects, designing the structure of wells, choosing methods of influencing the productive formation, calculating the operating modes of the "well - formation" system.

BRIEF DESCRIPTION OF THE COURSE

The course will cover basic engineering calculations and procedures for well completion. This course is designed to learn about the design and procedures of casing and tubing, as well as introduce some of the latest design techniques that are used in the completion of operations today.We will cover the basics of pore pressure / fracture gradient forecasting, casing and tubing design, cementing, wellheads, completion types and equipment, perforation and sand control. Will cover the basics of the load and the counter current, the definition of stress and the probability of failure. We will use graphs of pore pressure / crack gradient and casing installation depth to be able to design the required casing. Finishing types are taken into account when designing pipes (tension and movement) and selecting equipment for finishing. Finally the perforation and sand control are covered.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	Completion Competencies					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
To determine the pore pressure and fracture gradients of the borehole based on geological information	✓		✓			
To determine the load and the counter current, and power in any place in the wellbore.	✓	✓				
Determine the design criteria for casing and tubing for different types of columns		✓				
Describe the various advantages and disadvantages of the completion technique			✓		✓	
Describe various methods and equipment for sand control		✓				
Design graphs of the pore pressure of the crack gradient and the casing installation point	✓	✓				
Minimum cost of a combination of casing and tubing		✓	✓			
To design the cement job for the casing or liner				✓		
The design of the punching procedure			✓		✓	
To design the completion routine		✓				

PET242 – **Well construction and workover supervising**
CREDIT – 3 (2/0/1)
PREREQUISITE – **Oil and gas well drilling**

AIM AND OBJECTIVES OF THE COURSE

The aim of the course the students acquire the knowledge, aimed at the development of disciplinary competencies related to the basic technological processes in the construction of oil and gas wells, dependencies between decisive parameters of these processes and indicators of their efficiency, the used technical means, conditions of work, organization of work and management, with the methods of process design, operations, and analysis of their results; formation of the ability to independently use knowledge and skills in this and related fields of knowledge in practical activities..

BRIEF DESCRIPTION OF THE COURSE

The concept of the well and the method of drilling wells; Physical and mechanical properties of rocks; Classification and principle of operation of rock-cutting tools; Purpose and composition of the drill string; the Concept of drilling modes; Laws of operation of bits of various type models; Specifics of bit drives and basic requirements for downhole motors; technology and technique of drilling wells at pressure equilibrium in the "layer-well" system»; Technology of drilling wells in a given direction; History and prospects of development of drilling wells.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	Completion Competencies					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
choose and justify the methods of drilling wells in specific geological and technical conditions	✓					
✓to justify the choice of rock-breaking and auxiliary calibration-centering tools for drilling wells in various mining and geological conditions		✓	✓	✓	✓	
perform calculations of drill strings for strength and choose layouts for drilling different intervals		✓	✓	✓	✓	
✓perform calculations, selection and justification of parameters of drilling modes and evaluate their effectiveness			✓	✓	✓	✓
justify the choice of downhole motors for driving the bit						✓
perform calculations of the wellbore profile and offer natural, technical and technological means of controlling the wellbore trajectory					✓	
to assess the risks and determine measures to ensure safety when drilling		✓	✓			

PET211 – **Petroleum Reservoir Simulation: Compositional model**
CREDIT – 3 (2/0/1)
PREREQUISITE – **RE III: RS**

AIM AND OBJECTIVES OF THE COURSE

The purpose of this course is to develop students ' knowledge of compositional modeling of the oil recovery process using chemical methods to increase oil recovery. The main objectives of this course are the acquisition of students ' knowledge of compositional modeling and the formation of knowledge about the chemical composite model..

BRIEF DESCRIPTION OF THE COURSE

A typical flow in the application of chemical methods of oil production intensification is a composite flow, for which only the number of chemical components is set a priori, and the number of phases and the composition of each phase depend on the thermodynamic conditions and the total concentration of each component. In this course, we consider differential equations for a multicomponent, multiphase composite flow that involves mass transfer between phases. We describe a composite model that is widely used in the oil industry. An important method of increasing oil recovery is chemical flooding, such as flooding with solutions of alkaline, surfactants, polymer

and foam (ASP+foam). The injection of these chemical components reduces the mobility of the displacement fluid, which increases the efficiency of oil displacement. The basic differential equations for the chemical composition model studied during this course consist of from the mass conservation equation for each chemical component, the energy equation, Darcy's law, and the total mass or continuity conservation equation for pressure. The main assumptions imposed in the development of the basic equations for the composite model of chemical flooding are: (i) the solid and liquid phases are weakly compressible; (ii) the diffusion process obeys Fick's law; (iii) Darcy's law applies; (iv) the concept of local thermodynamic equilibrium can be used; and (v) the ideal mixing model can be applied. The equation of state is also briefly discussed in this course.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
to understand the dynamics of fluids in oil reservoirs	✓	✓	✓	✓	✓	✓
to formulate / write the basic differential equations for multicomponent, multiphase compositional flow	✓	✓	✓	✓	✓	✓
output the corresponding equations	✓	✓	✓	✓	✓	✓
simulate problems related to the hydrodynamics of underground fluids	✓	✓	✓	✓	✓	✓
to quantitatively describe the mass transfer in the oil reservoirs	✓	✓	✓	✓	✓	✓
have a basic understanding of the thermodynamic processes occurring in oil reservoirs	✓	✓	✓	✓	✓	✓
to calculate the thermodynamic properties	✓	✓	✓	✓	✓	✓
solve problems with chemical reactions and transport phenomena in oil reservoirs and wells	✓	✓	✓	✓	✓	✓

PET216 – Petroleum Reservoir Simulation: Black-oil model

CREDIT – 3 (2/0/1)
PREREQUISITE – **RE III: RS**

AIM AND OBJECTIVES OF THE COURSE

The aim of the course is to develop students ' knowledge of the basics of mathematical, numerical and hydrodynamic modeling of oil deposits. The objectives of the course are: mastering the basics of numerical methods for solving equations of multiphase flows in a porous medium and introducing students to the basics of scientific programming for computer implementation of mathematical models of multiphase filtration.

BRIEF DESCRIPTION OF THE COURSE

This course provides theoretical and practical knowledge about the basics of oil and gas reservoir modeling, which includes flow equations in a porous medium, methods for solving equations for modeling reservoir processes for undergraduates of the petroleum engineering program. This course covers the following topics: Introduction and unit conversion. Properties of formation rocks and fluids. Models of relative permeability. Basic differential equations for single-phase flow. Discretization of single-phase flow equations. Initial and boundary conditions. Numerical solution of differential equations of a single-phase flow. Various forms of differential equations for single-phase flow. Modeling of interblock conductivity. Models of a single-layer well. Connection of flow and well equations. Model multi-layered wells. Bondage models of the well and the reservoir. Basic differential equations for two-phase flow. Discretization of two-phase flow equations. Alternative differential equations of two-phase flow. Numerical solution of two-phase flow equations. Alternative formulations for two-phase incompressible flows. Implementation of initial conditions for the equations of the non-volatile oil model. Basic differential equations of the non-volatile oil model. Discretization of the equations of the non-volatile oil model. Rock / fluid properties for the non-volatile oil model. Numerical solution of the non-volatile oil model. Phase States for the non-volatile oil model. Simulation of saturation point problems. Finite volume method for unstructured meshes.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
know the basic models of the flow of a single-phase liquid in a porous medium			✓			
know the basics of modeling two-phase flow in a porous medium			✓		✓	
know the basics of modeling non-volatile oil						
learn how to set initial conditions for modeling			✓			
be able to build mathematical and numerical models of fluid flow in a porous medium						
be able to create a computer program for calculating filtration flows	✓	✓	✓	✓	✓	✓
be able to run the model for calculation	✓	✓	✓	✓	✓	✓
be able to analyze the results obtained	✓	✓	✓	✓	✓	✓
be competent in the field of mathematical, numerical and computer hydrodynamic modeling of oil and gas reservoirs	✓	✓	✓	✓	✓	✓

PET224 – Design of pumping and compressor stations
CREDIT – 3 (2/1/0)
PREREQUISITE – Design and operaton of oil and gas pipelines, Design and operation of pump and compressor stations

AIM AND OBJECTIVES OF THE COURSE

The main goal of the course is to acquire solid knowledge related to the regulation of station operation modes, maintenance and repair, diagnostics and testing of the main and auxiliary facilities of stations. Objectives of the course. Further familiarization with the main objects of service of pumping and compressor stations, the ability to manage the operating modes of pumping stations, familiarity with the system of operational control of the parameters of pumping and compressor stations, diagnosis of complex operating modes of gas pumping and pumping units. Competencies that undergraduates will possess at the end of the course: in the analysis of the operation of pumping and compressor stations; in the ability to manage the operating modes of pumping stations; in the analysis of the system of operational control of the parameters of pumping and compressor stations; in the skill of diagnosing complex operating modes of gas pumping and pumping units; in the use of compressor stations; in the ability to use scientific and technical and reference literature, determine the technical characteristics of pumps and compressors and assess their technical and economic efficiency.

BRIEF DESCRIPTION OF THE COURSE

The procedure for selecting the main and auxiliary equipment, regulating the operating mode when changing the mode of technological processes, calculating the change in the operating mode when changing the physical and chemical properties of the pumped working agent are considered.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Calculate the main parameters of pumping stations	✓	✓				
Determine the flow, head and efficiency using an analytical expression of the characteristics of a centrifugal pump	✓	✓				
Select the operating mode of pumping stations	✓	✓				
Be able to eliminate technical malfunctions of pumps				✓		
Calculate the main parameters of gas pumping units (GPA)				✓		✓
Select the operating mode of the GPA		✓				✓

Calculate the reliability indicators of the compressor unit		✓				✓
Determine the power at the inlet of the supercharger according to the parameters of the compressed gas				✓		✓

PET215 - Methods to improve the efficiency of gas and oil pipelines

CREDIT - 5 (1/0/1/3)

Prerequisite - Design and operation of oil and gas pipelines

AIM AND OBJECTIVES OF THE COURSE

To acquaint future specialists with methods of increasing the efficiency of gas and oilpipelines.

BRIEF DESCRIPTION OF THE COURSE

During the course of the discipline, undergraduates get acquainted with methods o increasing the efficiency of gas and oil pipelines, such as correct hydraulic calculation when using gas and oil pipelines, cleaning the internal cavity of the pipeline, calculatingthe bearing capacity of a gas and oil pipeline. The discipline considers the main issues of pipeline transportation of liquid and gaseous hydrocarbons, provides a classificationof pipelines and its main objects, the essence of technological processes associated withpumping oil and gas through main pipelines, as well as the sequence of technological calculations of main pipelines. improving the efficiency of gas and oil pipelines, such as correct hydraulic calculation when using gas and oil pipelines, cleaning the internal cavity of the pipeline, calculating the bearing capacity of the gas and oil pipeline.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, undergraduates and doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Know the classification and purpose of pipelines	✓	✓				✓
Perform calculations to determine the wall thickness of pipelines.	✓	✓				
Develop a plan for quality control of the construction of main pipelines				✓		
To predict and optimize the performance of pipeline with the use of modelling and assessment uncertainty.			✓			
Evaluate the condition of the internal cavity and pipeline junctions						
Apply knowledge, modern methods and software design tools for the preparation of design and operational and technological documentation of objects of collection, preparation, transport and storage of oil and gas	✓					

Basic approaches to the design of field and main pipeline systems, main and auxiliary equipment	✓			✓		
Perform simple hydraulic calculations and other calculations of pipelines with the use of specialized modern technology	✓					

PET261 – Basic Statistics for Petroleum Engineers

CREDITS – 5 (2/0/1/2)
PREREQUISITE – No

PURPOSE AND OBJECTIVES OF THE COURSE

SHORT DESCRIPTION OF THE COURSE

The course covers the theory of probability and its applications in petroleum engineering and science; probability distributions; parameter estimation; hypothesis testing; linear regression; spatial correlations and geostatistics.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
systematize knowledge about the types of information and basic statistical indicators;	✓			✓		
calculate basic statistical indicators, interpret and draw applied conclusions based on the accumulated data;	✓	✓				
measure the spread of the process, build confidence intervals and assess the risks of obtaining inappropriate products;	✓					
graphically visualize process data		✓		✓		

PET262 – Basic coding for Petroleum Engineers

CREDITS – 5 (2/0/1/2)
PREREQUISITE – No

PURPOSE AND OBJECTIVES OF THE COURSE

This course provides an introduction to practical software programming and its application in petroleum engineering. It explains how to create and run scripts and build modules to compute data during reservoir assessment, development, and drilling.

SHORT DESCRIPTION OF THE COURSE

This course provides an introduction to practical software programming and its application in petroleum engineering. It describes how to create and run scripts, build

modules for calculations during reservoir operation, development and drilling.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Know the basic types of algorithms;		✓				
Know the structured programming technology;		✓				
Know the basic elements of Python and C / C ++;	✓					
Know the basics of coding in Python and C / C ++ programming languages	✓					
Enter the initial data into the program and correctly interpret the results of its work;				✓		
Independently select the initial data for testing programs;						✓
Use standard software in research and professional activities.				✓		✓

PET240– Geosteering in drilling

CREDITS – 5 (2/0/1/2)
PREREQUISITE– No

GOALS AND OBJECTIVES OF THE COURSE

COURSE DESCRIPTION

The course covers the basics of telemetry, measurement and logging while drilling and directional drilling technologies, criteria for choosing the minimum required logging data set before performing geosteering, errors and uncertainties when drilling horizontal wells associated with both geology and the limitations of telemetry and logging tools, as well as methods for calculating the trajectory of a well, modern methods of geosteering, the basics of interpreting azimuthal logs, modeling various geosteering scenarios before drilling in order to manage risks.

COURSE OUTCOMES: KNOWLEDGE, SKILLS AND ABILITIES

Course outcomes – student outcomes matrix

Course Outcomes	**Criteries 3. Student's outcomes**					
Upon completion of the discipline, doctoral students should be able to	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Know the technologies for controlling the trajectory of the wellbore when drilling directional and horizontal wells;	✓			✓		✓
Know the basic professional terminology used in drilling when geosteering wells;			✓		✓	✓

Know the instrumentation base, devices and technologies for the production of geophysical measurements of well parameters, the angles of the spatial orientation of the drilling tool;	✓			✓		
Know the problems of wellbore trajectory control;	✓			✓		
Know the main ways of using and operating downhole measuring equipment when drilling directional oil and gas wells;	✓					
Know telemetry and directional devices, instruments for monitoring the parameters of the borehole of directional and horizontal wells.	✓					
Apply regulatory documents when measuring angles characterizing the position of the borehole axis in space for optimal guidance and adjusting the drilling trajectory;					✓	✓
Use the results of well logging, mud logging while drilling;	✓			✓		
Measure the angles characterizing the position of the borehole axis in space for optimal tracking and adjusting the trajectory of boreholes while drilling	✓					✓

PET260 – Advanced Rock Mechanics
CREDITS – 5 (2/0/1/2)
PREREQUISITE – **General and structural geology, Oil and gas drilling**

PURPOSE AND OBJECTIVES OF THE COURSE

SHORT DESCRIPTION OF THE COURSE

This module expands on existing knowledge in the field of rock mechanics, in particular with regard to the systematic design of excavation and support systems in rock massifs. It examines the strength and stress variability of rock mass at different scales and describes methods that engineers can learn for long-term planning and risk mitigation during drilling, production and reservoir development.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Matrix course results - professional competence results

Course Outcomes	**Completion Competencies**					
Upon completion of the discipline, doctoral students should be able to ...	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Understand the basic concepts of reservoir geomechanics	✓					✓
Predict pore pressure		✓			✓	✓
Build a summary map of complications on drilled wells.		✓				✓
Make calculations to determine the horizontal stress, the angle of internal friction and the coefficient of friction.		✓				✓
Assess the cumulative risks associated with wellbore stability	✓			✓		✓
Determine the optimal well trajectory taking into account the stability of the wellbore	✓				✓	✓
Predict and optimize well performance using well modeling and uncertainty estimates		✓	✓			✓
Identify critically loaded faults			✓	✓		
Build a geomechanical model						✓

ECA205 – Master's thesis defense
CREDIT – 12

AIM AND OBJECTIVES

Demonstration of the level of scientific/research qualification of a master's student, the

ability to independently conduct a scientific search, testing the ability to solve specific scientific and practical problems, knowledge of the most general methods and techniques for solving them.

BRIEF DESCRIPTION OF THE COURSE

Master's thesis – graduation qualification scientific work, which is a generalization of the results of independent studies undergraduates one of the pressing problems of a particular specialty relevant branch of science that has internal unity and reflects the progress and results of the development of the chosen topic.

Master's thesis – the result of research /experimental research work of a master's student, conducted during the entire period of study of a master's student.

The defense of the master's thesis is the final stage of the master's degree preparation. The master's thesis must meet the following requirements:

- The work must conduct research or solve current problems in the field of oil and gas;
- The work should be based on identifying important scientific problems and solving them;
- All decisions must be scientifically sound and reliable, and have internal unity.;
- The dissertation work must be written alone.

APPENDIX 1 - SPE COMPETENCY MATRIX

Matrix of competences for the "Formation Evaluation" SPE minimum competency task force			
	GENERAL KNOWLEDGE / SKILLS		
Objectives	**A RANGE OF MINIMUM COMPETENCE**	**DEPTH OF MINIMAL COMPETENCE**	**ABOVE THE MINIMUM COMPETENCE**
Determination of reservoir properties (porosity, saturation, effective thickness) by logging interpretation.	Determine properties from logging data in clean sands.	Determine properties from logging data in clean and shale Sands. Determine the saturation model of the most common water.	To determine the depth-shift and normalize in complex lithology, multi-well fields. To be competent in the use of software for estimation of the tank.
The definition of lithology by wireline logs.	Determine the lithology from a combination of porosity from logging in clean sands.	Determine the lithology from the combination of porosity from logging in clean Sands with mixed lithology.	Determine the depth of shear and normalization of the lithology in complex and multi-well deposits.
Formulation of the purpose of the hydrodynamic research program.	Determine what can be learned about the well and reservoir from traditional hydrodynamic procedures.	Given a set of property values required from a given reservoir, specify the types of data available to measure these properties.	Determine what can be learned about the well and reservoir from traditional and modern well testing, and specify the optimal types of data that are available to determine the required set of properties.

Design of well testing programs for compliance with the guidelines.	Determine the duration of the well test required to measure properties near the well and the formation in homogeneous, isotropic reservoirs.	Determine the duration of the well test required to measure properties near the well and the formation in homogeneous, isotropic reservoirs.	Determine the duration of well testing, flow rate (s), basic and special equipment to measure in situations with poorly defined wells and reservoir characteristics.
Determination of properties of the reservoir (drainage area pressure, permeability, skin factor, distance to boundaries) from well test.	To determine the reservoir properties for single-phase flow of oil or water in the building, or test a constant flow rate. The boundaries are limited to areas where there is no flow. The formation is homogeneous and isotropic.	To determine the reservoir properties for single-phase flow of oil or water in the building, or testing of constant speed. Boundaries include one, multiple, or complete closures. The formation is inhomogeneous and isotropic.	Determine reservoir properties for a multiphase flow of gas, oil and / or water using the PRC or multi-stage method. Reservoir boundaries can be closed, partially isolated, or kept under constant pressure. The formation may have complex heterogeneity, be anisotropic, and be at fluid contact in the test area of influence.
Formulation of the purpose of the cable test program	Formulate the objectives of the program testing on the cable.	Given a set of property values required from a given reservoir, specify the types of data available to measure these properties.	Determine what can be learned about the well and reservoir from traditional and modern equipment, and specify the optimal types of equipment that are available to determine the desired set of properties.
Determination of fluid density, contact and performance from the formation test on the cable.	Determine the gradients and therefore the densities and locations of the contacts from the pressure in the wire formation testers. To directly assess the performance of these tests.	Determine the gradients and therefore the densities and locations of the contacts from the pressure in the wire formation testers. Evaluate productivity from the results of analysis of test data in unsteady mode.	Determine the gradients and therefore the densities and locations of the contacts from the pressure in the wire formation testers. Evaluate the productivity and desired well type also from non-steady state test data using a multi-probe wire tester.

The design of sampling procedures for faces and surfaces to obtain a representative formation fluids.	To formulate the procedures commonly used for selection of sample black oil, volatile oil, dry gas, wet gas, and gas condensate.	Specify the sampling procedures at the face and surface to obtain a sample of black oil, volatile oil, dry gas, greasy gas, and gas condensate	Design of downhole and surface sampling procedures for obtaining a sample of black oil, volatile oil, dry gas, fat gas, and gas condensate. Based on data obtained in the field and in the laboratory, determine whether the sample is truly representative or not.
Determination of the purpose of the core sampling program and laboratory requirements.	Determine the properties obtained in established and special laboratory procedures, the usual laboratory procedures used in these tests, and their limitations.	Determine the properties obtained in established and special laboratory procedures, the usual laboratory procedures used in these tests, and their limitations. Establish the application of information to build geological and engineering models of the reservoir.	Taking into account the objectives of the formation study, establish detailed procedures to be used in the cores, the required number of cores, the types of measurement to ensure that the core study reaches its goals. Set how laboratory measurements should be converted to the data form required for the formation study.

Matrix of competences for the "Oil and gas well drilling"

SPE minimum competency task force

	GENERAL KNOWLEDGE / SKILLS		
Objectives	**A RANGE OF MINIMUM COMPETENCE**	**DEPTH OF MINIMAL COMPETENCE**	**ABOVE THE MINIMUM COMPETENCE**
Maintain the monitoring well.	Calculate the weight of the drilling mud required to maintain control of the well, and the volume of drilling mud required for topping up during lifting pipes from the	Design and / or perform a procedure to divide the developed fluid. Determine the type of fluid that appears from the data collected after the fluid occurrence. To understand the	Design and / or implement a procedure for successful control of underground discharge.

	well	relationship between geological reference depth and the reference depth of drilling.	
Develop a program for fixing the well (the size of the Casing, the design depth of the descent of the casing).	To develop a program to mount wells based on data from the combined graph of the pore pressure and the fracturing pressure. Understand the relationship between expected flow rate and well configuration (tubing / casing).	Determine the depth of installation of the conductor's casing shoe for isolation of aquifers. Plot a combined graph of pore pressure and hydraulic fracturing pressure.	Optimize the number of casing strings to be lowered into the well and their design depth of descent. Optimize the size of casing strings and shanks.
Design the casing.	To understand the basic principles of design (tensile strength, crushing strength, tensile strength).	Design the conductor, intermediate and production columns/shanks to maintain the integrity of the well.	Choose the optimal casing / connections for aggressive media (HPHT, H2S, salt, etc.).
Maintain compliance with regulatory requirements.	Understand the requirements for the protection of aquifers by lowering and cementing the conductor/ and the requirements for the program of conducting directional wells.	Understand the requirements for the protection of aquifers by lowering and cementing the conductor/ and the requirements for the program of conducting directional wells. Understand the regulatory compliance process. (For example, to develop a procedure for the elimination of areas where there may be overflows, to know what regulatory documents need to be prepared, and how to check compliance with regulatory requirements).	Calculate emissions from operations on drilling rigs (air pollution in % of engine exhaust gas units on the drilling rig, slurry oil, etc.).

Choose a cleanout program of the well.	Calculate the minimum weight of drilling mud required to create back pressure on the formation when drilling each well interval.	Design a well flushing program to maintain well control, taking into account the well anchoring program and reservoir integrity. Select the appropriate types of drilling fluids. Specify the properties of the drilling mud (for example, density and permissible filtration).	Optimize drilling mud costs by changing the inhibitory properties of the drilling mud. Establish critical minimum requirements for the inhibitory properties of drilling fluids.
Design the profile of the directional well (including the profile of horizontal / multi-barrel wells).	Understand the relationship between complexity and lateral displacement.	Understand the relationship between complexity and lateral displacement. Choose the appropriate depth of deviation of the shafts from the vertical, the intensity of the zenith angle set and the layout of the bottom of the drill string.	Optimize the program for wiring and fixing directional wells in order to avoid the formation of grooves on the walls of the curved trunk. Evaluate casing wear and develop a program to mitigate the problem. To develop a program for the transaction of horizontal and multilateral wells.
To pick up the equipment.	Recommend pressure testing of wellhead fittings and BOE defense to maintain the integrity of the well. Understand the operational properties of the drill string and BHA components	Select the configuration of the preventer unit, set the requirements for air defense pressure testing for the working pressure. Calculate the tonne-mile to re-equip the hoisting system. Calculate the crushing strength when the drill string is placed on wedges.	Design equipment for a special purpose drilling rig in order to optimize costs.

Develop a procedure for implementing a program to assess the parameters of a productive reservoir.	To understand the condition of the well bore to the success of the logging in the open hole wellbore.	Understand the relationship between the drilling mud formulation, the integrity of the bore, and the types of logging that can be successfully performed in the well.	o design a procedure for conducting well testing in challenging conditions. (for example, HPHT, mobile offshore drilling rig).
Develop a hydraulic drilling program.	Understand the basic principles of fluid mechanics and non-Newtonian fluids.	Calculate the pressure drop in the elements of the circulation system and optimize the hydraulics of the bit. Understand the principles of equivalent circulation density.	Integrate the hydraulic program with the geological conditions and the flushing program.
Develop a program to regulate the content of the solid phase.	Understand the basic operations for regulating the content of the solid phase.	Select standard equipment for regulating the solid phase content (vibrating screen, sand separator and silt separator) for the hydraulic drilling program.	Design an environmentally safe closed system.
To develop a program of cementing	Understand regulatory requirements (protection of aquifers, isolation of zones, etc.). Understand the use of basic cement additives.	Develop formulations of cement mortars with appropriate pumpability and other necessary requirements for successful cement works. Understand the use of special cement additives.	Design cement works for wells drilled in difficult conditions (shallow inflows of reservoir water, underground emissions, etc.).

Matrix of competences for the "Reservoir Engineering"

SPE minimum competency task force

Objectives	GENERAL KNOWLEDGE / SKILLS		
	A RANGE OF MINIMUM COMPETENCE	**DEPTH OF MINIMAL COMPETENCE**	**ABOVE THE MINIMUM COMPETENCE**
Understanding and applying standard and special core analysis.	Understand traditional laboratory methods for determining diameter, permeability, and saturation, and know how to interpret the data.	Use data from standard core analysis to group / correlate core data and determine changes in permeability and heterogeneity.	Understand and apply specific core analysis, including capillary pressure / saturation-depth ratios, correlations with logging data, free water level / transition zone estimation, pore size distribution, and relative permeability.
The provision of reservoir properties.	Understand how standard core analysis is used to determine effective thickness and contacts.	Understand how standard core analysis is used to determine effective thickness and contacts.	Using core and RFT data, integrate reservoir dynamics and well testing with geoscience data to determine reservoir layering and continuity. Link the measured data to the known sedimentary environment.

Conducting logging analysis and interpretation.	Understand the importance of various logging to well correlations of petrophysical data.	Apply logging results (resistivity, FDC / CNL, gamma logging and acoustic logging in open wells, and CBL, TDT, carbon, oxygen and production well logging) to correlate porous and non-porous lithological elements from logging data and core. To interpret the logging in the production wells.	To carry out quantitative interpretation and analysis in open hole and cased wells. Determine the pressures in the individual layers and the contribution to the total flow from each individual layer.
Performing PVT analysis.	Understand the value of oil, gas and water PVT data and measurement, as well as application methods.	Evaluate the validity of PVT data, and adjust the results to correct errors. Evaluate PVT data from oil and gas properties and correlations.	Calculate PVT data from oil and gas compositional analysis using a correlation or non - EOS (equation of state) model.
Understanding and defining the behavior of the oil and gas phase.	Understand the principles of phase behavior to distinguish the General properties and behavior of black oil, volatile oil, dry gas, fat gas, and gas condensate reservoir.	Understanding the principles of the equation of state and its use in fluid characterization.	Identify / analyze compositional effects.
Determination of the initial conditions of the formation and fluid contacts.	Calculate the Bo above the saturation point using the compressibility factor.	To calculate the reservoir pressure from interpretation of RFT / MDT.	Estimate reservoir pressure from the interpretation of the unsteady pressure test
Single / multiphase flow analysis under reservoir conditions.	To calculate the Bo above the point of saturation with the use of the compressibility factor.	o evaluate the productivity effects of relative permeability, absorption, inhomogeneity and gravitational / capillary / viscous forces, fluid flow calculations.	Evaluate the productivity effects of relative permeability, absorption, inhomogeneity, and gravitational / capillary / viscous forces.

Determination of oil or gas reserves in reservoir conditions.	To calculate the reserves of oil or gas in situ properties of rocks and fluids in geological and thermal. Understand the principle of material balance to determine the initial oil or gas in reservoir conditions.	Apply material balance methods, including gas cap and water inflow, to determine the initial oil and gas in reservoir conditions.	Include The j-curve Sw-depth in the inventory count. Work out different forms of material balance and determine the most appropriate form to apply for any type of situation for inventory counting.
Use the traditional well testing method to understand and perform the analysis.	To understand the design principles of well testing and analysis to evaluate the performance of the well and the reservoir.	Apply gdis methods (including LIL, PRC, injection test) to determine the characteristics of the well and reservoir. Calculate vertical / horizontal well productivity indicators.	Be familiar with tests and data from stimulated wells (hydraulic fracturing, acid treatment) and the use of tracers to analyze fluid flow paths. To calculate the skin effect of cold water for the injection wells.
Application of appropriate oil and gas reserves determination.	Understand the difference between different categories of inventory, including proven, probable, and possible categories.	Understand the difference between different categories of inventory, including proven, probable, and possible categories.	Understand and be able to apply statistical methods or estimate the reserve using probability, using appropriate ranges of uncertainty and probability estimates.
Performing an assessment of oil and gas production.	Understand the appropriate ranges of recovery factors for a given rock and fluid properties and formation modes.	Evaluate the appropriate recovery factor ranges and calculate recoveries for a field or reservoir using traditional (deterministic and representation) reservoir management methods.	Develop methods to improve the recovery rate for a wide range of rock and fluid properties for different recovery methods using different methods.

Understanding the fluid flow characteristics of oil reservoirs and determining reservoir performance.	Understand different methods for evaluating reservoir performance based on production data.	Apply the principles of reservoir regime, material balance, pressure maintenance, recovery, drop analysis and volumetrics to determine the oil reservoir performance. Determine where to perforate production and injection wells, taking into account the degree of connection between pressure and impermeable rocks.	Apply cone and multi-phase methods of analysis for the calculation of oil recovery and optimal field development. Recommend when to stop production and re-complete the well.
Analysis of reservoir / liquid recovery under secondary or advanced extraction mechanisms.	Know the main mechanisms for improving oil recovery and have a high assessment of their application	Understand the principles of reservoir / fluid behavior and recover processes when mixing, chemical flooding, steam-based thermal and combustion processes.	Application of the design process concept (e.g. profile control, pressure, temperature, fluid composition, pick-up, etc.) to calculate the incremental extraction performance.
Understanding and application of processes for the extraction of unconventional gas reservoirs.	Know the basic extraction processes from unconventional gas reservoirs, including shale and coal seams.	Calculate reserves and well / reservoir performance; understand the principles of coalbed methane production performance.	Understand analysis of gas production and water removal for the extraction of coal bed methane. Evaluate the recovery of coalbed methane.

Evaluation of reservoir performance using reservoir simulation.	Understand and apply simulations to analyze performance and optimize field development.	Use basic field development principles, including flow through porous media, relative permeability, nodal analysis, and multiphase flow to evaluate single wells and oil or gas reservoirs.	Become familiar with specialized modeling techniques (such as matrix solving methods, numerical analysis, vectorization, finite element / difference analysis, and parallel processing). Identify areas of the reservoir that are picked up or irrationally drained and identify new well locations with geological input. Know and be able to use software to characterize the reservoir, adapt the model, and predict future results.
Understand and apply decision & risk analysis to assess the factor of distractibility and predict performance of the reservoir.	Understand the concepts of decision-making and risk analysis and have an assessment of the key factors that determine the uncertainty of the recovery rate and reservoir performance.	It can determine the main field developments and geological and geophysical factors that affect the recovery rate, the number of wells required and the production profile.	Can quantify reservoir engineering uncertainties in the context of other uncertainties, using appropriate uncertainty ranges and appropriate decision-making and risk analysis techniques.
Observations of the reservoir.	Know the basics of tank surveillance. Ability to access basic information and provide ideas for improvement.	Ability to give accurate recommendations for improving productivity through re-completion, drilling new wells, injection well placement, etc. Develop plans and procedures for the same effect.	Develop short - and long-term production plans and reserves for reservoirs. Actively follow well performance and provide solutions to problems.

Matrix of competences for the "Petroleum production engineering"

SPE minimum competency task force

Objectives	GENERAL KNOWLEDGE / SKILLS		
	A RANGE OF MINIMUM COMPETENCE	**DEPTH OF MINIMAL COMPETENCE**	**ABOVE THE MINIMUM COMPETENCE**
Tubing design for production / stimulation conditions	Understand that the column is shrinking or lengthening due to changes in pressures and temperatures during stimulation and mining.	Can calculate the exact change in the length or strength of the packer due to the piston effect buckling of the pipe, temperature, helically twisting.	Design the same for high temperature / pressure in a corrosive environment, such as H2S, CO2, impact on the design.
The procedure of killing and abandonment of a well.	Calculate the density of the well-killing fluid, show general awareness of the need to conduct the operation safely, following the company and regulatory requirements and the geometry of the wellbore at the recommended depths.	Having knowledge of sequential steps, for example, is safe eliminate also and mount for initial operations; maintaining proper well management in all operations; ability to correctly establish a sequence of operations with multiple stages of operations, including equipment extraction and zone isolation.	Design in difficult conditions, for example, the main fishing operations, crumpling of the casing, emissions, swabbing.

Hydraulic fracturing / acid treatment.	Know the main models of hydraulic fracturing gradient and key parameters. Calculate the base pressure drop in the system due to friction, taking into account all the parameters of the processing pressure on the fence.	Calculate the required flow rate considering the pressure loss and speed limit. Change the density of the perforation to feed the volume at a given speed and a fixed surface pressure to different zones, as well as the size and strength when selecting the proppant. The ability to combine enable the desired P/I in design and Economics.	Adapt additives / fluid rheology for high temperature, high pressure.
The overhaul procedure includes the following works: pressure cementing and re-completion of the well.	Understand the use of cementing data to identify problem areas, be able to calculate hydrostatic pressure involving two or more fluids of different densities, cement volume, pipe volume, awareness of the need to conduct the operation safely, following company and regulatory requirements and the geometry of the wellbore at recommended depths.	Have knowledge of sequential steps, for example, the download schedule for a preset or balanced traffic jam. Ability to calculate the appropriate shot density / perforation size of the required mining conditions.	Design pressure cementing for gas slippage or horizontal pipes, micro-crack replenishment.

Nodal analysis.	o know that the optimal configuration during production is a function of the initial flow characteristics, pressure differences in the wellbore, surface condition and wellbore configuration, it will be necessary to take into account changes in reservoir behavior and changes in the composition of the extracted fluid during the entire production life cycle.	The ability to design the appropriate configuration of the wellbore given the initial and planned characteristics of the inflow, the state of the surface, the composition of the extracted fluid.	The ability to design an appropriate wellbore configuration under near-surface conditions, such as subsea or deep-water operations or high-pressure, high-temperature completion with non-hydrocarbon components.
The surface equipment.	Know the effects of changes in pressure and temperature on the composition of the extracted liquid and the main equipment for separating and bringing the hydrocarbon to marketable quality.	The ability to design ground - based equipment to separate extracted fluids, process liquids to marketable quality, and / or deliver a product for sale.	The ability to design ground - based equipment to separate extracted fluids, process liquids to marketable quality, and / or deliver a product for sale.

Mechanized method of mining	Know the various options to assist in lifting the extracted fluids; the main pressure ranges and fluid volumes for each lifting option; and the hydraulic and mechanical forces associated with each option.	The ability to select and design an appropriate production system for a typical range of pressures and fluid volumes for traditional operations, including the use of various downhole pumps associated with ground equipment. Combine the desired P/I in the design and evaluation of the economy of the completion/ mechanized mining method.	Design an appropriate production method for completion of horizontal wells or severe conditions such as Arctic; offshore or subsea operations.
Logging in production wells.	Know the basic CBS to ensure mechanical integrity, measure downhole parameters, evaluate hydrocarbon potential, and support downhole operations, including completion, cleaning, and disposal.	The ability to interpret and incorporate data from logging operations into the design and execution of operations such as completion, cleaning and disposal for traditional oil and gas wells.	The ability to interpret and incorporate data from logging operations into the design and execution of operations such as completion, cleaning and disposal for horizontal, high pressure, high temperature wells or in complex well control situations.
Production tracking	Know the basics of production tracking. Ability to access basic information and provide ideas for improvement.	Ability to give accurate recommendations for improving production. Develop surveillance plans and procedures.	Develop short-and long-term goals for large field assets. Actively follow the performance wells and provide solutions to problems.

APPENDIX 2 - EMPLOYER REVIEWS

Институт полимерных материалов и технологий

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Review of the graduate program
"6M070800 – Petroleum Engineering"

Reviewer: Iskander Gussenov
PhD in Petroleum Engineering
Engineer at PO "Institute of
Polymer Materials and Technology"
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After I review the graduate program, I can conclude the following. The graduate program 6M070800 is designed for petroleum engineers who pursue master of technical science. This two-year, full-time program is supposed to provide students a solid scientific background in different branches of petroleum engineering, including hydrocarbon exploration, reservoir management, fluid dynamics, reservoir simulation and enhanced oil recovery. Also, the students have a wide choice to elect specific courses like advanced petrophysics, reservoir evaluation methods, geomechanics, drilling and placement of horizontal and multilateral wells, advanced economy assessment of petroleum industry projects, just to name a few. In my opinion, the inclusion of these elective courses into the tuition program is necessary to train the students to effectively utilize the workflow concepts now prevailing in the oil industry, and prepare them to work in multidisciplinary teams.

I would also like to highlight that the tuition program includes research and pedagogical practice modules, which are obligatory for all students. Thus, the program is not just about formal lectures, problem classes and computer exercises. It is supposed to develop research skills and pedagogical background, which, in my opinion, makes it different from undergraduate courses.

Hopefully, after completing the obligatory course "history and philosophy of science" students will become more interested in acquiring additional knowledge of physics, chemistry and applied mathematics through their future careers. Also this course can help understand how science, technology and society interact with one another, at different times, in different places and on different issues. History and philosophy of science I studied during my master's program at the University has turned out to be one of the most valuable courses I ever had.

Based on the above, I can recommend the graduate program to be implemented, as, in my opinion, it meets the requirements laid out for the future professionals in Petroleum Engineering.

Sincerely,
PhD, Iskander Gussenov

Almaty/January 2019

Исх.№: 003

28.01.2019

РЕЦЕНЗИЯ

на программу послевузовского образования

по специальности – «Нефтегазовое дело»

Образовательная программа по специальности – «Нефтегазовое дело» разработана заведующим и профессорско-преподавательским составом кафедры «Нефтяная инженерия» Института геологии и нефтегазового дела имени К.Турысова КазНИТУ имени К.И.Сатпаева.

Образовательная программа по специальности «Нефтегазовое дело» определяет программные образовательные цели, результаты обучения обучающихся, необходимые условия, содержание и технологии для реализации образовательного процесса, оценку и анализ качества обучающихся вовремя обучения и после окончания. ОП включает учебную программу, содержание дисциплин и результаты обучения и другие материалы для обеспечения качественного образования обучающихся.

Образовательная программа содержит модуль обязательных дисциплин и дисциплины по выбору, знания которых позволяют освоить научно-исследовательский модуль и практико-ориентированный модуль.

Таким образом, рецензируемая Образовательная программа по специальности – «Нефтегазовое дело» позволяет готовить специалистов конкурентноспособных как внутри страны, так и на международном рынке труда и интегрировать национальную программу в мировое образовательное пространство, а также отвечает требованиям нормативно-правовых документов, регламентирующих разработку ОП.

Рецензент

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С уважением,

Директор **Мұнара Аскар**

СӘТБАЕВ УНИВЕРСИТЕТІ SATBAYEV UNIVERSITY

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Ref: 13/64
05.02.2019

To: **Head of Petroleum Engineering Department**
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From: **A. Jamankulov**
Asset Development Lead
for NCSPSA & Pearls
Shell Kazakhstan Development B.V.

REVIEW OF THE PETROLEUM ENGINEERING GRADUATE PROGRAM

Shell Kazakhstan employees (Arman Jamankulov Asset Development Lead for NCSPSA & Pearls, Jasmeet Saluja Asset Development Lead for KGK, Zhuldyz Galiakpar Social Performance Advisor) visited Satpayev University, Oil & Gas faculty during the 15th – 16th Nov 2018 trip. The purpose of the visit to get acquainted with current education program and initiate Industry Advisory Board (IAB).

The graduating department «Petroleum engineering» carries out development and implementation of professional educational program in the specialties of the graduated studies and is responsible for the compliance of the educational process with the state compulsory standard of graduate education and the qualification requirements for licensing educational activities.

The department «Petroleum engineering» that implements professional graduated study programs provides:

- Graduated students have a chance for research internship at The University of Lorraine (France); including research center LEMTA, engaged with mechanical engineering. Some of the students currently doing their research with Colorado School of Mines (USA) and The Pennsylvania State University (USA).
- The department has six research grants financed by government, four research projects are sponsored by private oil companies and foundations, one grant for commercialization of obtained research results. Research areas cover main petroleum domains: transportation, drilling, reservoir and production engineering. Graduate students have the potential for conducting relevant research that meet the conditions of oil and gas industry.
- Department has a computer class with certain software's available for simulation of some petroleum processes from geology to transportation. Educational licenses were granted by Schlumberger.

The scientific component of the educational program formed from research work (for educational programs of scientific and pedagogical direction) or experimental research work (for specialized educational programs), the preparation of scientific / methodical publications and the implementation of a thesis for the academic degree of (PhD) or doctor in profile.

The graduate educational program in petroleum engineering provides necessary knowledge, research skills and gives certain opportunities. We refer to the assessment and recommendations given by Dr. Erdal Okzhan, professor and department head of petroleum engineering.

Asset Development Lead
for NCSPSA & Pearls
Shell Kazakhstan Development B.V.

A. Jamankulov

APPENDIX 3 - REVIEW OF PARTNER UNIVERSITIES

PennState

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January 29, 2019

To Whom It May Concern:

I have looked at the Master Degree program in petroleum engineering that is under development at Satbayev University and have got some thoughts as follows.

Global energy consumption is growing rapidly as the world is developing. However, oil and gas resources will be much less accessible in future, and far more advanced technology will be required to extract them. This means that the future hydrocarbon production will deal with unconventional resources, such as heavy oil, shales, gas hydrates and tar sands. The petroleum industry, therefore, needs more highly qualified engineers specializing in a wide range of areas.

All specialty aspects of graduate petroleum engineering program that meet Department of Petroleum Engineering faculty's areas of expertise can serve as potential specialization areas for both course selection and thesis topics. Example areas of particular emphasis by the department include reservoir engineering, reservoir pressure maintenance by waterflooding and gas injection, tertiary recovery, computational fluid flow, drilling, process economics, computer-visualization of petroleum systems and transportation of oil and gas by pipelines.

The programs aim to provide students with all the skills and knowledge necessary for their chosen profession so that they are immediately operational upon graduation. The programs also prepare them for changes that will occur in the context of the current power generation transition.

The educational program offering knowledge of the physics of reservoirs and rock-fluid interactions should be key factors for optimizing production. The complementary skills of engineers are essential to its success. Through this program, students should master the methods and tools used to optimize more sustainable production of oil and gas fields.

Students in the subject areas of process and petroleum engineering at Satbayev University benefit from the detailed instruction they receive on a suite of industry-standard software packages that include: PETREL, Eclipse, tNavigator, Techlog, KAPPA and PIPESIM.

There is a lot of research going on in many different areas. Chemicals for fracturing, new hydraulic fracturing techniques, new chemicals for EOR, new ways to produce from oil sands including SAGD and VAPEX processes, new algorithms for reservoir and geomechanics simulations, ways to couple rock mechanics and fluid flow simulations, ways of upscaling, production of coal bed methane. There is a special laboratory with modern equipment at Satbayev University to support these research activities.

However, the reviewed program has no support discipline in physical chemistry helping students to better understand a variety of processes taking place in some petroleum engineering technologies such as the enhanced oil recovery. In addition, a discipline that describes how different loads impact the materials stability and possible degradation would also be useful.

In summary, my conclusion is that the petroleum engineering graduate program at Satbayev University is dignified program comparing to any other international prototype.

Sincerely,

Serguei Lvov

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Director, Electrochemical Technologies Program of the EMS Energy Institute