NJSC «Kazakh national research technical university named after K.I. Satpayev»

Institute of Geology, Petroleum, and Mining EngineeringPetroleum Engineering Department

EDUCATIONAL PROGRAM

«PETROLEUM ENGINEERING»

Doctor of Philosophy (Ph.D.) 8D07202 – «Petroleum Engineering»

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

Almaty 2022

СӘТБАЕВ УНИВЕРСИТЕТІ SATBAYEV UNIVERSITY

The educational program was developed by faculty of the Department of Petroleum Engineering

PE Department Head G.Zh. Yeligaybeva

agreed:

Director of the G&PE Institute A.Kh. Syzdykov

From employers:

1 Amangali Nysangaliev, Doctor of Technical Sciences, Advisor to the Director of KMGP LLP

From the academic partner:

1 Agzamov Farit Akramovich, Doctor of Technical Sciences, Professor of the Ufa State Petroleum Technical University.

Approved at a meeting of the Educational and Methodological Council of the Kazakh National Research Technical University named after K.I. Satpayev. Minutes No. 3 dated 25.06.2021

Qualification:
Level 8 of the National Qualifications Framework:
8D07 Engineering, manufacturing and construction industries
8D072 Manufacturing and processing industries

Professional competence: Determination of strategy, management of processes and activities, decision-making and responsibility at the level of institutional structures. Ability for leadership, autonomy, analysis, assessment and implementation of complex innovative ideas in scientific and practical fields. Competent communication in a specific field of scientific and professional activity.

CONTENTS

page

BRIEF DESCRIPTION OF THE PROGRAM 4

The purpose of developing an educational program 4

Normative documents used for the development of this EP 5

General provisions in the development of EP 6

Professional and labor activity 7

Contact Information 7

PASSPORT OF THE EDUCATIONAL PROGRAM 8

Scope and content of the program 8

Requirements for applicants 9

Requirements for completing studies and obtaining a diploma 9

Working curriculum of EP "Petroleum Engineering" 13

Descriptors of the level and knowledge, abilities, skills and professional competencies 16

ECTS Diploma Supplement 17

DESCRIPTION OF COURSES 19

APPENDIX 1 - SPE COMPETENCY MATRIX 47

APPENDIX 2 - EMPLOYER REVIEWS 52

APPENDIX 3 - REVIEW OF THE UNIVERSITY'S PARTNER 53

BRIEF DESCRIPTION OF THE PROGRAM

The purpose of developing an educational program

The main postgraduate education program (hereafter, the EP) for Ph.D. studies, administered by the Kazakh National Technical Research University, named after the K.I. Satpayev, approved by the Ministry of Education and Science of the Republic of Kazakhstan in the direction of "Petroleum Engineering," is a system of documents produced and approved taking into account the requirements of the labor market on the basis of the national higher education level.

The EP shall govern the priorities, expected outcomes, content, requirements and technology for the implementation of the educational process, the evaluation of the standard of graduate training in this field of training and shall include the curriculum, the work programs of the modules/disciplines, the practice programs and other materials to ensure quality education.

The development and management of the Postgraduate Education Program "Petroleum Engineering" shall be carried out in accordance with the standard and working curriculum for the terminated specialty 6D070800 "Oil and Gas Engineering" establishedby the Kazakh National Research Technical University named after Satpaev and approved in the prescribed manner.

The educational program submitted for accreditation complies with the criteria of the State Level for Postgraduate Education. The implementation of the educational program and the plan for its creation is carried out by the Department of Petroleum Engineering of the Institute of Geology, Petroleum and Mining Engineering named after K. Turysov.

The key aim of the program is:

– the development of general cultural competencies of graduates (competencies of social interaction, self-organization and self-government, of a hierarchical nature of activity), the implementation of a competency-based approach to the formation of general cultural competencies of graduates should be ensured by a combination of educational and extracurricular work; the requisite socio-cultural environment;

– the formation of the general technical and professional competence of the graduates.

The PhD program is an educational research work that involves in-depth theoretical and (or) experimental and practical research in the field of fundamental and (or) applied science.

Normative documents used for the development of the 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 "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 SES 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 December 10, 2018);

– 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 December 10, 2018);

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

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

– Sample SPE (Society of Petroleum Engineers) Curriculum, 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 objectives of the educational program (Program Educational Objectives, hereinafter PEO), which are closely related to the mission of the program.

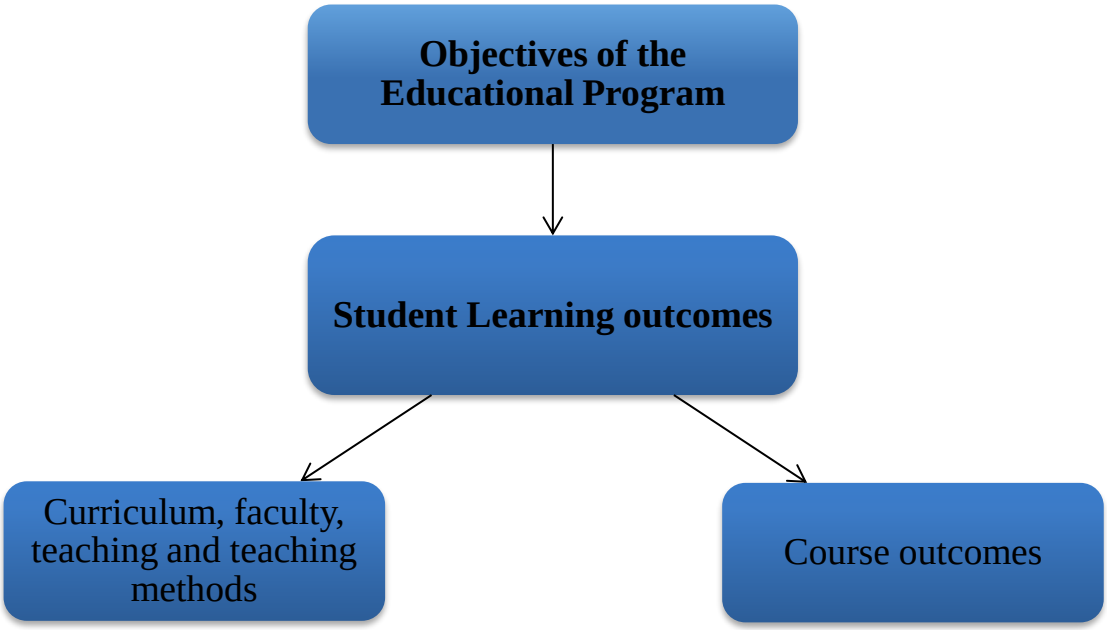

Figure 1 - The relationship of different components in the definition of the educational program

A field of professional activity or a professional category is a collection of types of labor activity in an industry that has a common integration basis (similar or similar intent, artifacts, technologies, including labor tools) and presupposes a similar set of labor functions and skills for their implementation.

The category of work or professional subgroup is part of a professional group, a set of professions shaped by an integral set of work functions and the competencies required for their implementation.

PhDs include research and development, methodology and design and construction methods, implementation and management of technical processes and production in the fuel energy sector, including the construction of wells on land and offshore, and field development. Possible workplaces: study centers, research and design organizations, higher education institutions, research and development centers, production organizations, service providers, government departments, public and political organizations, etc.

Table 1 indicates five core fields of professional activity and 21 forms of job activities for EP 'Petroleum Engineering' graduates in accordance with the sectoral qualification system. The current classification of the SQF lacks the direction "Reservoir

Engineering"-physical and chemical methods, mechanisms and processes occurring in the reservoir and a qualitative explanation of these phenomena. Thus, EP "Petroleum Engineering" involves the best practices of the oil and gas industry in the world, at the same time focused on current historical traditions.

Table 1 - Areas of professional and work activities in the oil and gas industry, according to the SQF (8-level: Doctoral studies)

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

Contacts

Murat Syzdykov, Head of Petroleum Engineering Department,
22a Satbayev St., Oil building, 711.
Phone.: 8-727-320-4058
email: M.Syzdykov@satbayev.university

PASSPORT OF THE EDUCATIONAL PROGRAM

1 The Program Scope

The educational program of the Doctor of Philosophy (Ph.D.) study has both research and pedagogical focus and involves fundamental educational, methodological and research work and coursework relevant to the system of postgraduate education.

The doctorate educational program entails fundamental educational, methodological and research preparation and study of disciplines in the relevant areas of science for the branches of the national economy, the social sphere: education, medicine, law, art, economics, business administration and in the field of national security and military affairs.

Our Ph.D. educational program is developed on the basis of studying experiences of foreign universities and research centers that implement accredited Ph.D. programs.

The content of the educational program of specialized doctoral studies is established by the university independently.

The main criterion for the completeness of the educational process for the preparation of doctors of philosophy (PhD) (doctor in the profile) is the completing at least 180 academic credits by a doctoral student, including all types of educational and scientific activities.

The term of study in doctoral studies is determined by the amount of acquired academic credits. Upon mastering the established number of academic credits and achieving the expected learning outcomes for obtaining a PhD or profile, the doctoral education program is considered fulfilled.

Training of personnel in doctoral studies is carried out on the basis of doctoral educational programs in two directions:

1) scientific and pedagogical with a training period of at least three years;

2) specialized with a training period of at least three years.

The EP Objectives

– in-depth research and interpretation of the theoretical and methodological foundations used to examine the topical problems of the related branch of science in the profile of the scientific field;

– training skills for independent study, technical and teaching activities;

– develop the capacity, through original scientific research, to contribute to the advancement of the latest developments in science in the corresponding branch of the country and the world;

– ensure the acceptance of doctoral students in the international educational and scientific community and in the labor market;

– create the capacity to build, conceptualize and execute projects aimed at generating new knowledge of significant scientific significance in the field of fuel energy.

2 Admission Requirements

Applicants with a Master's degree and work experience of at least 1 (one) year or who have completed residency training are admitted to doctoral studies.

Enrollment in the number of doctoral students is carried out by the admissions committees of universities and scientific organizations based on the results of the entrance examination for groups of doctoral studies and a certificate confirming proficiency in a foreign language in accordance with the common European competences (standards) of foreign language proficiency.

When enrolling in universities, doctoral students independently choose an educational program from the corresponding group of educational programs.

The enrollment of persons for the targeted training of doctors of philosophy (PhD) under the state educational order is carried out on a competitive basis.

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

The formation of the contingent of doctoral students 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" the doctoral student must have all the prerequisites necessary for mastering the relevant professional doctoral curriculum. The list of required prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the doctoral student is allowed to master them on a paid basis. In this case, doctoral studies begin after the doctoral student has fully mastered the prerequisites.

3 Requirements for completing studies and obtaining a diploma

Applicants who have mastered the educational program of doctoral studies and defended their doctoral dissertation, with a positive decision of the dissertation councils of a university with a special status or the Committee for Control in the Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, based on the results of the examination, are awarded the degree of Doctor of Philosophy (PhD) or Doctor of Science in profile and issued a state diploma with an attachment (transcript).

Persons who have received a PhD degree, to deepen scientific knowledge, solve scientific and applied problems on a specialized topic, carry out a postdoctoral program or conduct research under the guidance of a leading scientist chosen by the university.

3.1 Requirements for key competencies of doctoral graduates:

1) have an idea:

- about the main stages of development and the change of paradigms in the evolution of science;

- on the subject, ideological and methodological specifics of the natural (social, humanitarian, economic) sciences;

- about scientific schools of the relevant branch of knowledge, their theoretical and practical developments;

- on the scientific concepts of world and Kazakh science in the relevant field;

- on the mechanism of implementation of scientific developments in practice;

- about the norms of interaction in the scientific community;

- about the pedagogical and scientific ethics of the scientist-researcher;

2) know and understand:

- modern trends, directions and patterns of development of domestic science in the context of globalization and internationalization;

- methodology of scientific knowledge;

- achievements of world and Kazakh science in the relevant field;

- (to understand and accept) the social responsibility of science and education;

- perfect foreign language for scientific communication and international cooperation;

3) be able to:

- organize, plan and implement the process of scientific research;

- analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;

- analyze and process information from various sources;

- to carry out independent scientific research, characterized by academic integrity, based on modern theories and methods of analysis;

- generate your own new scientific ideas, communicate your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;

- to choose and effectively use modern research methodology;

- plan and predict your further professional development;

4) have skills:

critical analysis, assessment and comparison of various scientific theories and ideas;

- analytical and experimental scientific activities;

- planning and forecasting research results;

- oratory and public speaking at international scientific forums, conferences and seminars;

- scientific writing and scientific communication;

- planning, coordination and implementation of research processes;

- a systematic understanding of the field of study and demonstrate the quality and effectiveness of the selected scientific methods;

- participation in scientific events, fundamental scientific domestic and international projects;
- leadership management and team leadership;
- responsible and creative attitude to scientific and scientific-pedagogical activities;
- conducting patent search and experience in transferring scientific information using modern information and innovative technologies;
- protection of intellectual property rights to scientific discoveries and developments;
- free communication in a foreign language;

5) be competent:

- in the field of scientific and scientific-pedagogical activity in conditions of rapid renewal and growth of information flows;
- in carrying out theoretical and experimental scientific research;
- in the formulation and solution of theoretical and applied problems in scientific research;
- in conducting a professional and comprehensive analysis of problems in the relevant area;
- in matters of interpersonal communication and human resource management;
- in matters of university training of specialists;
- in the examination of scientific projects and research;
- in ensuring constant professional growth.

3.2 Requirements for research and development work of a student under the PhD program:

1) compliance with the main problems of the educational program of doctoral studies, on which the doctoral dissertation is being defended;

2) is relevant and contains scientific novelty and practical significance;

3) is based on modern theoretical, methodological and technological achievements of science and practice;

4) is based on modern methods of data processing and interpretation using computer technology;

5) carried out using modern scientific research methods;

6) contains scientific research (methodological, practical) sections on the main protected provisions.

3.3 Requirements for the organization of practices:

The practice is carried out with the aim of developing practical skills in scientific, scientific, pedagogical and professional activities.

The educational program of doctoral studies includes:

1) teaching and research practice - for student’s in

2) industrial practice - for students under the program of specialized doctoral

studies.

During the time of pedagogical practice, doctoral students engage, if possible, in the teaching of undergraduate and graduate classes.

The research activity of a doctoral student is carried out with the intention of researching the current theoretical, methodological and technical advances of domestic and international sciences, as well as consolidating practical skills, applying modern research methods, analyzing and interpreting experimental data in the field of dissertation.

The industrial practice of a doctoral student is carried out in order to enhance the theoretical knowledge learned in the learning process and to develop the professional standard.

The content of study and industrial practice is determined by the subject of the doctoral dissertation.

4 Working curriculum of EP "Petroleum Engineering"

4.1.

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**							
	MET322	Research methods	BD IC	5	150	2/0/1	105		AAP345	Doctoral student research work, including internships and doctoral dissertations	DSRW	24				
	LNG305	Academic writing	BD IC	5	150	2/0/1	105		AAP350	Pedagogical practice	BD	10				
		Elective	PS OC	5	150	2/0/1	105									
		Elective	PS OC	5	150	2/0/1	105									
		Elective	BD OC	5	150	2/0/1	105									
		In total		**25**						**In total**		**34**				
2	**3 semester**								**4 semester**							
	AAP345	Doctoral student research work, including internships and doctoral dissertations	DSRW	24					AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25				
	AAP355	Research scientific training	PS	10												
		In total		**34**						**In total**		**25**				
3	**5 semester**								**6 semester**							
	AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25					AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25				
									ECA303	Writing and defending doctoral dissertation	FA	12				
		In total		**25**						**In total**		**37**				
										In all		**180**				

CATALOG OF DISCIPLINES

Year	Code of Electives	Code	Name of profile disciplines	Component	Credits	lec/lab/pra	Prerequisites
1	1302	PET231	Advanced Gas Engineering	P	5	2/0/1	PET438
		PET224	Design of pumping and compressor stations			2/1/0	PET428
		PET206	Applied Well Testing			2/0/1	PET442
		PET216	Petroleum Reservoir Simulation: Black-Oil Model			2/0/1	PET433
		PET242	Well construction and workover supervising			2/1/0	PET440
		PET222	Advanced Production Engineering			2/0/1	PET438
		PET215	Methods to improve the efficiency of oil and gas pipelines			1/0/1	PET427
		PET212	Applied well stimulation			2/0/1	PET440
	1303	PET 240	Geosteering in drilling	P	5	2/1/0	PET432
		PET236	Advanced well completion			2/0/1	PET426
		PET260	Advanced Rock Mechanics			2/0/1	PET411
		PET261	Basic Statistics for Petroleum			2/0/1	PET417
		PET228	Advanced Petrophysics			2/0/1	PHY111
		PET262	Basic Coding for Petroleum Engineers			2/0/1	MAT103
		PET211	Petroleum Reservoir Simulation: Compositional model			2/0/1	CSE677
		PET213	Enhanced oil recovery			2/0/1	PET173
	1204	PET226	Principles of Reservoir engineering	B	5	2/0/1	PET431
		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
		PET229	Advanced Reservoir Engineering			2/0/1	PET418
		PET232	Advanced Production Engineering			2/0/1	PET439
		PET230	Advanced Thermodynamics and Phase Behavior of Reservoir Fluids			2/0/1	PET409
			Total		15		

5 Descriptors of the level and knowledge, abilities, skills and professional competencies

The third level descriptors within the Comprehensive Qualifications Framework of the European Higher Education reflect learning outcomes that characterize the student's abilities:

1) demonstrate a systematic understanding of the area of study, mastering the skills and research methods used in this area (prescribe the area);

2) demonstrate the ability to think, design, implement and adapt the essential research process with a scientific approach;

3) contribute with their own original research to expand the boundaries of the scientific field, which deserves publication at the national or international level;

4) critically analyze, evaluate and synthesize new and complex ideas;

5) communicate their knowledge and achievements to colleagues, the scientific community and the general public;

6) to promote, in an academic and professional context, the technological, social or cultural development of a knowledge-based society.

Table 2 - Description of Competencies for EP Petroleum Engineering and their relationship with the sectoral qualifications framework for the oil and gas industry (8-Level, Doctorate)

Competencies and their brief descriptions according to the EP Petroleum Engineering at the KazNRTU namedafter K. Satpayev					
Knowledge	**Methodology**	**Teaching**	**Research skills**	**Communication**	**Professionalism**
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**

By the end of the program, doctoral students will be able to apply advanced knowledge of oil and gas engineering in their professional and academic careers.	By the end of the program, doctoral students will be able to apply appropriate analytical methods, both qualitative and quantitative, collect and integrate information in the best way and in accordance with oil and gas industry standards	By the end of the program, doctoral students will be able to demonstrate skills in teaching in an undergraduate program, working with and supervising students	By the end of the program, doctoral students will be able to conduct independent original research that contributes to the development of oil and gas science and the industry, according to the best practices and industry standards.	By the end of the program, doctoral students will be capable of communicating, both written and oral, in a professional and ethical manner.	By the end of the program, doctoral students will demonstrate high professionalism and ethics while interacting with various stakeholders

Sectoral qualifications framework for the oil and gas, refining and petrochemical industries8-Level (Doctorate)						
Characteristics of knowledge			**Characteristics of skills and abilities**			
(1)	(2)	(3)	(1)	(2)	(3)	(4)
Knowledge at the most advanced level in the field of science and professional activity. Use specialized knowledge to critically analyze, evaluate and synthesize new complex ideas that are at the forefront of the field.	Evaluation and selection of information 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.	Demonstrate an ability of sustained interest in developing new ideas or processes and a high level of understanding of learning processes.	Research, develop, implement and adapt projects leading to new knowledge and new solutions.	The most advanced and specialized skills and abilities, including synthesis and assessment, required to solve critical problems in research and / or innovation, and to allow for the revisionand updating of existing knowledge or professional practice.	Ability to participate verbally or in writing in professional discussions and publish research baseline results in international academic journals. Can contribute to the scientific and professional level of the technical, social and cultural progress of society.	Ability to generate ideas, predict the results of innovative activities, to carry out large-scale changes in the professional and social spheres, to manage complex production and scientific processes.

6 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.

DESCRIPTION OF COURSES

MET321 – Research methods

CREDITS – 5 (2/0/1/2)

PREREQUISITE–

GOALS AND OBJECTIVES OF THE COURSE

COURSE DESCRIPTION

The training course allows you to gain knowledge on the basic theoretical provisions, technologies, operations, practical methods and techniques for conducting scientific research based on the modern achievements of domestic and foreign scientists and master the skills of choosing a topic for scientific research, scientific research, analysis, experimentation, data processing, obtaining reasonable effective solutions using information technology. The course includes: the concept of science and scientific research, methods and methodology of scientific research, methods of collecting and processing scientific data, principles of organizing scientific research, methodological features of modern science (differentiation, integration, systems approach, abstraction, concretization, synergetic paradigm, evolutionism , logic, instrumental analysis, etc.), ways of developing science and scientific research, the role of technical sciences, informatics and engineering research in modern science, the structure of technical sciences, the use of general scientific, philosophical and special methods (including marketing and investment) scientific research in theory and practice.

COURSE OUTCOMES: KNOWLEDGE, SKILLS AND ABILITIES

Course outcomes – student outcomes matrix

Course outcomes	**Criteries 3. Student's outcomes**					
Upon completion of the discipline, students should be able to	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
know the methodology of scientific research.		✓		✓		
know the methodology of fundamental scientific research		✓		✓		
apply theoretical and practical knowledge in the process of conducting independent scientific research,				✓	✓	
process fundamental and relevant scientific information in the chosen field,						✓
independently make generalizations and scientific conclusions.				✓		

LNG304 – Academic writing
CREDITS – 5(2/0/1/2)
PREREQUISITE– LNG 203

GOALS AND OBJECTIVES OF THE COURSE

The aim of the course is to develop skills and competencies in the field of research and development of skills in writing qualification studies.

COURSE DESCRIPTION

The study of the discipline is based on the development and improvement of skills in the field of written scientific and methodological communication, which provides a high level of training for doctoral students necessary for effective communication in the scientific and academic environment. The objectives of the discipline are to familiarize doctoral students with the basic requirements for writing in a scientific language; developing the skills of expressing reasoned ideas and opinions in writing, using professional vocabularyand terminology; development of text editing skills; teaching the techniques of correct and logical construction of the structure of scientific research; preparation for writing articles, scientific papers and annotations; the study of techniques for the free and reasoned presentation of thoughts on a scientific professional problem.

COURSE OUTCOMES: KNOWLEDGE, SKILLS AND ABILITIES

Course outcomes – student outcomes matrix

Course outcomes	**Criteries 3. Student's outcomes**					
Upon completion of the discipline, students should be able to	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
know the grammatical phenomena necessary for writing, translation and editing;		✓				
know complex syntactic constructions of scientific and business speech;		✓				
know the technologies of structuring the academic text;		✓				
apply the knowledge gained in the preparation and writing of a research paper in writing;						✓
freely read the original literature of the relevant branch of knowledge in a foreign language;		✓				
work with bibliography;		✓				
formalize information received from foreign sources in the form of translation, annotation and annotation;					✓	✓
compare the content of different sources of information on the problem of scientific research, critically evaluate the opinion of the authors;				✓		✓

PET231 – Advanced Gas Engineering
CREDIT – 5 (2/0/1/2)
PREREQUISITE – **Natural gas engineering**

AIM AND OBJECTIVES OF THE COURSE

The purpose of the discipline is to familiarize undergraduates with current technologicaltrends 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 theinfluence 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	✓	✓	✓	✓	✓	✓

PET224 – Optimization of pumping and compressor stations

CREDITS – 5 (2/0/1/2)

PREREQUISITE–Design and operation of gas and oil pipelines, Design and operation of pumping and compressor stations

GOALS AND OBJECTIVES OF THE COURSE

The main goal of the course is to acquire solid knowledge related to the regulation of the operation modes of stations, maintenance and repair, diagnostics and testing of the main and auxiliary facilities of the stations.

Objectives of the course. Further acquaintance with the main objects of servicing 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 the pumping and compressor stations, diagnosing complex operating modes of gas pumping and pumping units.

Competencies that doctoral students will possess at the end of the course: in the analysis of the operation of pumping and compressor stations; in the ability to control the operating modes of pumping stations; in the analysis of the system of operational control of the operating parameters of pumping and compressor stations; in the skill of diagnosing complex operating modes of gas pumping and pumping units; in using the skills of designing pumping and compressor stations; in the ability to use scientific, technical andreference literature, to determine the technical characteristics of pumps and compressorsand assess their technical and economic efficiency.

COURSE DESCRIPTION

This course gives an idea of the purpose of pumping and compressor stations on the main pipeline, determining the main technical indicators of pumping and compressor units, regulating the operating mode of pumping and compressor units in different situations. The skills of regulating the operating mode of pumps and compressors, taking into account their characteristics, control and operation of main and auxiliary equipment are considered.

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)**
Calculate the main parameters of pumping stations	✓	✓				
Determine the flow rate, head and efficiency using the analytical expression of the characteristics of a centrifugal pump	✓	✓				

Select the operating mode of pumping stations	✓	✓				
Be able to troubleshoot technical problems with pumps				✓		
Calculate the main parameters of gas pumping units (GCU)				✓		✓
Select GPU operating mode		✓				✓
Calculate the reliability indicators of the compressor unit		✓				✓
Determine the power at the blower inlet by the parameters of the compressed gas				✓		✓

PET 206 – Applied Well Testing

CREDITS – 5 (2/0/1/2)

PREREQUISITE – **Geophysical studies of reservoir parameters**

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of teaching the discipline is to form students' knowledge of the basic principles of well testing, as well as to use this knowledge in solving various problems. This course is designed to improve students' self-study skills. Consequently, students should consciously devote sufficient time and energy to reading, understanding and applying knowledge and skills in the classroom. Lectures will be held in a discussion form based on what students have learned and missed while working on the problems.

SHORT DESCRIPTION OF THE COURSE

This discipline covers the basic concepts of well test analysis, analytical and graphical methods for interpreting well test data. In addition, this course covers typical curve analysis, nodal analysis, and fracturing wells.

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 physical essence of the processes occurring in the reservoir during the movement of reservoir fluids		✓				
Understand the basics of well testing	✓	✓				
Interpret data from hydrodynamic studies of oil and gas wells using traditional and modern methods of analysis				✓	✓	
Distinguish the tasks of hydrodynamic research and select the types of research to solve these problems			✓		✓	

Apply pressure swing testing to determine well and reservoir characteristics, i.e. skin, permeability, distance to boundaries apply well testing with variable flow rates to determine the characteristics of the well and the formation, i.e. skin, permeability, reservoir volume					✓	✓

PET216 – Reservoir Modelling: Black-oil model
CREDITS – 5 (2/0/1/2)
PREREQUISITE– **Reservoir Engineering III: Reservoir modelling**

GOALS AND OBJECTIVES OF THE COURSE

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

COURSE DESCRIPTION

The main topics of this course are: introduction to numerical modeling, overview of reservoir and fluid properties, continuity equation, Darcy equation for single-phase and multiphase flows, types of cells, determination of initial and boundary conditions,practical application of numerical modeling for solving problems of primary and secondary production.

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 basic models of a single-phase fluid flow in a porous medium;			✓			
know the basics of modeling a two-phase flow in a porous medium;			✓		✓	
know the basics of modeling fixed oil;						
master the ways of setting the 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 simulation of oil and gas reservoirs.				✓		

PET242 – **Well construction and workover supervision**
CREDITS – 5 (2/0/1/2)
PREREQUISITE – **Drilling oil and gas wells**

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the discipline is the acquisition of knowledge by students aimed at mastering disciplinary competencies related to the main technological processes in the construction of oil and gas wells, the dependencies between the determining parameters of these processes and indicators of their effectiveness, with the technical means used, their working conditions, with the organization of work and managing them, with methods of designing processes, operations, works and analysis of their results; formation of the ability to independently use knowledge and skills in this and related fields of knowledge in practice.

SHORT DESCRIPTION OF THE COURSE

This course will allow students to acquire knowledge and skills in the field of technological control and management of construction processes, maintenance and overhaul of oil and gas wells (supervising) in accordance with the technical design and work programs.

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)**
choose and justify the methods of drilling wells in specific geological and technical conditions	✓					
substantiate the choice of rock cutting and auxiliary calibrating-centering tools for drilling wells in various mining and geological conditions		✓			✓	
make strength calculations of drill strings and select layouts for drilling various intervals		✓				

make calculations, selection and justification of the parameters of drilling modes and evaluate their effectiveness				✓		
substantiate the choice of downhole motors for driving the bit						✓
make calculations of the wellbore profile and offer natural, technical and technological means to control the wellbore trajectory					✓	
assess risks and determine safety measures while drilling wells		✓	✓			

PET222 – **Advanced Production Engineering**
CREDITS –5 (2/0/1/2)
PREREQUISITE – **Technique and technology of oil and gas production**

PURPOSE 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 to optimize oil production processes.
Objectives of the course: 1) Study the main directions of the solution and master the solution of problems for assessing the productivity of wells, the choice of the 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 orderto improve the efficiency of wells. 3) To develop skills in the development of measures to increase the turnaround time of wells and the mean time between failures of downhole equipment.

SHORT DESCRIPTION OF THE COURSE

This course covers inflow performance relationships and multiphase pipe flow and constraints analysis using flow correlations. Prediction of the flow structure for vertical, horizontal and inclined pipes using various correlations and numerical simulations to optimize oil production, both with gushing and mechanized systems, is considered.

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)**
Conditions for the effective use of various well pumping units			✓	✓		

The main production processes that represent a single chain of oil and gas technologies.			✓		✓	
Main economic indicators characterizing the efficiency of production processes for the development of hydrocarbon deposits.		✓				
Work in software products for modeling the development process at the "advanced user" level			✓		✓	
To systematize, analyze and use the initial information to calculate indicators of oil field development processes		✓				
Calculate the main technological indicators	✓	✓				
Apply methods for calculating technological development indicators using modern software;			✓	✓		
Analyze and substantiate the decisions taken aimed at increasing the technological and economic efficiency of the process of extracting hydrocarbons from deposits				✓		
Skills analysis and assessment of the efficiency of oilfield equipment operation			✓		✓	
Analyze the causes of downhole pumping equipment failures and plan measures to increase the MTBF of downhole equipment.		✓				

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 oil pipelines.

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 classification of 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	✓					

PET212 – **Applied well stimulation**
CREDITS – 5 (2/0/1/2)
PREREQUISITE – **Oil and Gas Development II: Secondary and Tertiary Production Techniques**

PURPOSE 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.

SHORT DESCRIPTION OF THE COURSE

This course, in addition to the basic concepts of reservoir damage, acidizing and hydraulic fracturing, provides insight into reservoir types and basic reservoir properties, geological properties and reservoir properties for vertical, horizontal and multilateral wells.
The course also includes monitoring the quality of acid treatment and hydraulic fracturing, carrying out these activities, monitoring pressure and other critical parameters during and after stimulation.

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 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 RMS			✓			
Explain the dependence of intensification on production rates.						
Analyze production stimulation data by field	✓				✓	
Justify the choice of reservoir stimulation methods		✓	✓			

PET240– Geosteering in drilling

CREDITS – 5 (2/0/1/2)
PREREQUISITE–

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	✓					✓

PET236 – **Advanced well completion**
CREDITS – 5 (2/0/1/2)
PREREQUISITE – Drilling of the wells

PURPOSE AND OBJECTIVES OF THE COURSE

The main goal of the course is to promote the development of scientific and technical thinking and the acquisition of necessary knowledge and practical skills by students in the field of drilling and well completion.
Objectives of the course: Students must acquire the skills of competently choosing the method of opening productive objects, designing wells, choosing methods of influencing the productive stratum, calculating the modes of operation of the "well-reservoir" system.

SHORT DESCRIPTION OF THE COURSE

This course covers the fundamentals of advanced well completion technologies, including smart wells and autonomous inflow control devices. The course will explore the different types of advanced completion and associated technology programs. Trainees will be introduced to petroleum engineering for advanced well completion programs such as project evaluation, well performance modeling, and reservoir simulation. This course will introduce the techniques and workflows by which you can select the appropriate advanced completion technology.

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)**
Determine the pore pressure and fracture gradient of the well based on geological information	✓		✓			
Determine the load and counterflow and force anywhere in the wellbore.	✓	✓				
Define design criteria for casing and tubing for various types of strings.		✓				
Describe the various advantages and disadvantages of completion techniques			✓		✓	

Describe different methods and equipment for sand control		✓				
Design pore pressure / fracture gradient plots and casing locations	✓	✓				
Lowest cost of a combination of casing and tubing		✓	✓			
Design a cement job for a casing or liner				✓		
Design a perforating procedure			✓		✓	
Design completion procedure		✓				

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						✓

PET261 – Basic Statistics for Petroleum Engineers

CREDITS – 5 (2/0/1/2)
PREREQUISITE –

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		✓		✓		

PET228 - Advanced Petrophysics

CREDIT – 5 (2/0/1/2)
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	✓	✓	✓	✓	✓	✓

PET262 – Basic coding for Petroleum Engineers

CREDITS – 5 (2/0/1/2)

PREREQUISITE –

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.				✓		✓

PET211 – **Reservoir Modelling: Compositional model**
CREDITS – 5 (2/0/1/2)
PREREQUISITE– **Reservoir Engineering III: Reservoir modelling**

GOALS AND OBJECTIVES OF THE COURSE

The purpose of this course is to form students' knowledge of compositional modeling ofthe oil recovery process using chemical methods of enhanced oil recovery.
The main objectives of this course are the acquisition by students of knowledge on compositional modeling and the formation of knowledge about the chemical compositional model.

COURSE DESCRIPTION

This course examines the numerical modeling of an oil and gas reservoir using equationsof state such as Penga-Robinson, Redlich-Kwong, and multi-component flow equations for secondary and tertiary oil and gas production. Topics include, but are not limited to: viscosity and density models, plots of relative permeabilities, capillary pressure, and examples of gas and chemical injection for enhanced oil recovery.

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)**
understand fluid dynamics in oil reservoirs;			✓			
formulate / compose basic differential equations for multicomponent, multiphase compositional flow;			✓		✓	
derive the corresponding equations;						
to simulate problems related to the hydrodynamics of underground fluids;			✓			
quantitatively describe mass transfer in oil reservoirs;						

have a basic understanding of the thermodynamic processes occurring in oil reservoirs;	✓				✓	
calculate thermodynamic properties;		✓	✓			
solve problems with chemical reactions and transport phenomena in oil reservoirs and wells.				✓		

PET 213 - Enhanced Oil Recovery Techniques

CREDIT - 5 (2/0/1/2)

PREREQUISIT - Field Development II, III, Principles of Oil Production Technologies, Well Testing and Interpretation

---

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, aswell as processes of oil displacement.	✓				✓	
Experiment on your own present and argue your opinion				✓	✓	✓
Prepare an article for publication				✓		✓

PET 227 - Principles of production engineering

CREDIT - 5 (2/0/1/2)

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				✓		✓

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 – 5 (2/0/1/2)
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.			✓			

PET 248 – Advanced drilling fluids

CREDITS – 5 (2/0/1/2)

PREREQUISITE– Drilling fluids

GOALS AND OBJECTIVES OF THE COURSE

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.

COURSE DESCRIPTION

This course covers advanced knowledge of the functions and properties of drilling fluidson various foundations and intended for formation penetration, also circulation loss and sticking problems and their solutions, well cleaning, hydraulic calculations, measurements of properties of drilling mud in laboratory conditions and in operation. realtime on the rigs. In addition, the course will enable trainees to design, control and adjustmud parameters to achieve drilling goals in a safe and efficient manner.

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 operating conditions of drilling fluids in the well	✓					
Know and apply the method 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 fluid				✓		
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 formulation of the drilling fluid	✓	✓				

PET229 - Advanced Reservoir Engineering
CREDIT – 5 (2/0/1/2)
PREREQUISITE – **RE I: PR, RE II: STR, RE III: RS**

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 theeffect 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 thereservoir

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 predictthe 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	✓	✓	✓	✓	✓	✓

PET 232 – Advanced Economic Analysis of Oil and Gas Projects
CREDIT – 5 (2/0/1/2)
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				✓		✓

PET230 - Advanced thermodynamics and phase States of reservoir fluids

CREDIT – 5 (2/0/1/2)

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.

.

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.		✓	✓			✓

APPENDIX 1 - SPE COMPETENCY MATRIX

Reservoir Assessment Competence Matrix

SPE Task Force on Minimum Competence

	GENERAL KNOWLEDGE / SKILLS

Task	RANGE OF MINIMUM COMPETENCE	DEPTH OF MINIMUM COMPETENCE	ABOVE MINIMUM COMPETENCE
Determination of reservoir properties (porosity, saturation, net thickness) by log interpretation.	Determine properties from well log data in clean sands.	Determine properties from well log data in clean and shale sands. Determine the saturation model of the most common water.	Determine the depth of shear and normalization in complex lithology, multi-well fields. Be competent in using reservoir assessment software.
Determination of lithology by logging.	Determine lithology from a combination of porosity from a clean sand log.	Determine lithology from a combination of porosity from clean sands with mixed lithology.	Determine the depth of the shear and then normalize the lithology in complex and multi-well fields.
Formulation of the goal of the hydrodynamic research program.	Formulation of the goal of the hydrodynamic program to determine what can be learned about the well and the reservoir from their traditional study. гидродинамических процедур.	Given a set of property values required from a given reservoir, specify the study types available to measure these properties.	Determine what can be learned about the well and the reservoir from traditional and modern well testing, and also indicate the optimal types of study that are available to determine the required set of properties.

Well test program design for compliance with 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 for measuring in situations with poorly defined wells and reservoir characteristics.
Determination of reservoir properties (pressure drainage area, permeability, skin factor, distance to boundaries) from well testing.	Determine reservoir properties for single phase flow of oil orwater in build-up, or constant flow testing. Borders are limited to areas where there is no flow. The reservoir is homogeneous and isotropic.	Determine reservoir properties for single phase flow of oil orwater in build-up, or constant velocity tests. Boundaries includesingle, multiple, or complete closures. The reservoir is heterogeneous and isotropic.	Determine reservoir properties for a multiphase flow of gas, oil and / or water using pressure build-up or multi-stage method. The formation boundariescan be closed, partially isolated or kept at constant pressure. The formation can have complex heterogeneity, anisotropic and be atfluid contact in the zone of influence of the test.
Statement of the goal of the cable test program.	Formulate the goals ofthe cable test program.	Given a set of property values required from a given reservoir, specify the study types available to measure these properties.	Determine what can be learned about the well and the formation from traditional and modern equipment, and also indicate the optimal types of equipment that are available to determine the required set of properties.
Determination of fluid density, contacts and performance from wireline formation testing.	Determine the gradients and therefore the density and pin locations versus pressure in wired formation testers. Assess productivity directly from test data.	Determine the gradients and therefore the density and pin locations versus pressure in wired formation testers. Estimate productivity from the analysis of the transient test data.	Determine the gradients and therefore the density and pin locations versus pressure in wired formation testers. Estimate productivity and desired well type also from transient test data using a multi-probe wireline tester.

Design of downhole and surface sampling procedures to obtain representative reservoir fluids.	Formulate the procedures commonly used for sampling black oil, volatile oil, dry gas, wet gas, and gas condensate.	Specify bottom and surface sampling procedures to obtain a sample of black oil, volatile oil, dry gas, wet gas, and gas condensate.	Design of downhole and surface sampling procedures to sample black oil, volatile oil, dry gas, wet gas, and gas condensate. Based on data obtained in the field and in the laboratory, determine whether the sample is truly representative or not.
Define the purpose of the coring program and laboratory requirements.	Determine the properties obtained in specified and specific laboratory procedures, routine laboratory procedures used in these tests, and their limitations.	Determine the properties obtained in specified and specific laboratory procedures, routine laboratory procedures used in these tests, and their limitations. Establish the application of information for building geological and engineering models of the reservoir.	Taking into account the objectives of the reservoir study, establish detailed procedures to be used in the cores, the required number of cores, and types of measurements to ensure that the core study achieves its objectives. Establish how laboratory measurements should be converted into data form required for reservoir studies.

Oil and Gas Well Drilling Competence Matrix

SPE Task Force on Minimum Competence

Task	GENERAL KNOWLEDGE / SKILLS		
	RANGE OF MINIMUM COMPETENCE	DEPTH OF MINIMUM COMPETENCE	ABOVE MINIMUM COMPETENCE
Maintain well control.	Calculate the weight of drilling fluid required to maintain control of the well and the volume of drilling fluid required to top up while pulling the pipes out of the well.	Design and / or implement a procedure for flushing out the emerged fluid. Determine the type of manifested fluid from the data collected after the fluid manifested. Understand the relationship between geological reference depth and drilling reference depth.	Design and / or implement a procedure to successfully control an underground release.
Develop a well casing program (well dimensions, design depths of well running).	Develop a well casing program based on the data of the combined pore pressure and fracture pressure graph. Understand the relationship between expected production rate and well configuration (tubing / casing).	Determine the depth of the conductor shoe to isolate the aquifers. Build a combined pore pressure versus fracture pressure plot.	Optimize the number of casing strings run into the well and their design running depth. Optimize casing and liner sizes.
Design the casing.	Understand basic design principles (tensile strength, crushing strength, tensile strength).	Design a casing, intermediate and production strings / liners to maintain well integrity.	Select optimal casing strings / connections for aggressive media (HPHT, H2S, salt, etc.).
Maintain regulatory compliance.	Understand the requirements for protecting aquifers by lowering and	Understand the regulatory compliance process. (For example, develop a procedure	Calculate emissions from operations on drilling rigs (air pollution in% of

	cementing a surface conductor / and the requirements for a directional well drilling program.	for eliminating areas where crossflows are possible, know what regulations need to be prepared, and how to verify compliance with regulations).	exhaust gases from engines of units on a drilling rig, sludge oil, etc.).
Select a well flushing program.	Calculate the minimum weight of drilling mud required to create back pressure on the formation while drilling each section of the well.	Design a well flush program to maintain well control, taking into account the well casing program and reservoir integrity. Select appropriate types of drilling fluids. Indicate the properties of the drilling fluid (for example, density and permissible filtration).	Optimize drilling fluid costs by modifying the inhibiting properties of the drilling fluid. Establish critical minimum requirements for the inhibitory properties of drilling fluids.
Design a directional well profile (including a horizontal / multilateral well profile).	Understand the relationship between complexity and lateral displacement.	Select appropriate borehole deflection depths, inclination rates, and bottom hole assembly.	Optimize the directional well drilling and casing program to avoid the formation of grooves on the walls of the deviated wellbore. Assess casing wear and develop a program to mitigate the problem. Develop a program for drilling horizontal and multilateral wells.
Select equipment.	Recommend pressure testing of wellheads and BOP to maintain well integrity. Understand the performance of the drill string and BHA components	To select the configurations of the preventer block, to establish the requirements for the pressure testing of the BOP to the operating pressure. Calculateton-mile for tackle system refitting.	Design equipment for a special purpose drilling rig to optimize costs.

		Calculate the crushing strength when seating the drill string on wedges.	
Develop a procedure for implementing a program for assessing the parameters of a productive formation.	Understand the condition of the wellbore for successful open hole logging.	Understand the relationship between mud formulation, wellbore integrity, and the types of logs that can be successfully performed downhole.	Design a well testing procedure in difficult conditions. (for example, VDVT, 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 bit hydraulics. Understand the principles of equivalent circulating density.	Integrate hydraulic program with geological conditions and flush program.
Develop a program to control the solids content.	Understand basic solids control operations.	Select standard solids control equipment (shaker, sand separator, and sludge separator) for the hydraulic drilling program.	Design an environmentally friendly closed system.
Develop a cementing program.	Understand regulatory requirements (aquifer protection, zone isolation, etc.). Understand the use of basic cement additives.	To develop formulations of cement slurries with appropriate pump ability 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 formation water flows, underground emissions, etc.).

Competence Matrix for Oil and Gas Development
SPE Task Force on Minimum Competence

Task	GENERAL KNOWLEDGE / SKILLS		
	RANGE OF MINIMUM COMPETENCE	**DEPTH OF MINIMUM COMPETENCE**	**ABOVE MINIMUM COMPETENCE**
Understanding and applying standard and custom core analysis.	Understand traditional laboratory methods for determining Ø, permeability and saturation, and know how to interpret the data.	Use data from standard core analysis to group / correlate core data and determine the change in permeability and heterogeneity.	Understand and apply special core analysis including capillary pressure / ratios saturation –depth, correlations with log data, estimate of free water level / transition zone, pore size distribution and relative permeability.
Representation 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 bedding and continuity. Relate measured data to a known sedimentary environment.
Logging analysis and interpretation.	Understand the importance of various log-to-well correlation petrophysical data.	Apply log results (resistivity, FDC / CNL, gamma ray and sonicopen hole, and CBL, TDT, dip log, carbon, oxygen and production log) to correlate porous and non-porous lithological elements from log data and core. Interpret production logs.	Perform quantitative interpretation and analysis in open holeand cased hole. Determine the pressures in 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 measurements, as well as application methods.	Evaluate the validity of the PVT data, and adjust the results to correct errors. Evaluate PVT data from oil and gas properties and correlations.	Calculate PVT data from compositional analysis of oil and gas using correlation or non- EOS (equation of state) models.
Understanding and defining the behavior of the oil and gas phase.	Understand the principles of phase behavior in order to distinguish the general properties and behavior of black oil, volatile oil, dry gas, wet 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 reservoir and fluid contacts.	Calculate Bo above the saturation point using the compressibility factor.	Calculate reservoir pressure from RFT / MDT interpretation.	Estimate reservoir pressure from test interpretation transient pressure
Analysis of single / multiphase flow in reservoir conditions.	Calculate Bo above the saturation point using the compressibility factor.	Evaluate the effects of productivity relative permeability, absorption, heterogeneity and gravity / capillary/ viscous forces, fluid flow calculations.	Evaluate productivity effects of relative permeability, absorption, heterogeneity, and gravity / capillary/ viscous forces
Determination of oil or gas reserves in reservoir conditions.	Calculate reservoir oil or gas reserves from rock and fluid properties and geological isopach. 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 J-Curve Sw - Depth in Stock Calculation. Work on various forms of material balance and determine the most suitable form to apply for any type of situation for calculating stocks.
Using the traditional well test method to understand and	Understand the principles of well test design and analysis to	Apply well testing methods (including KVK, pressure build-up, injection test) to determine the	Be familiar with tests and data from stimulated wells (fracturing, acidizing) and using tracers to analyze fluid

perform the analysis.	evaluate well and reservoir characteristics.	characteristics of the well and the formation. Calculate vertical / horizontal well productivity indicators.	flow paths. Calculate the skin effect of cold water for injection wells.
Application of appropriate definitions of oil and gas reserves.	Understand the distinction between different categories of a stock, including proven, probable, and probable.	Understand the distinction between different categories of a stock, including proven, probable, and probable.	Understand and be able to apply statistical methods or estimate the provision using probability using appropriate ranges of uncertainty and probability of estimates.
Assessment of oil and gas production.	Understand the appropriate ranges of recovery rates for agiven rock and fluid properties and reservoirregimes.	Estimate relevant ranges of recovery factors and calculate recoveries for a field or reservoir using traditional (deterministic and representational) reservoir regimes.	Develop methods to improve recovery rates for a wide range of rock and fluid properties for different recovery methods using different methods.
Understanding the flow characteristics of oil reservoirs and determining the productivity of the reservoir.	Understand the various methods for evaluating reservoir performance from production data.	Apply the principles of reservoir behavior, material balance, pressure maintenance, recovery, drop analysis and volumetrics to determine the productivity of the oil reservoir. Determine where to perforate production and injection wells, taking into account the degree of relationship between pressure and impermeable rocks.	Apply cone and multiphase analysis methods to calculate oil recovery and optimal field development. Recommend when to stop production and re-completion the well.
Understanding the flow characteristics of gas reservoirs and determining	Understand the various methods for evaluating reservoir performance from production data.	Apply the principles of reservoir behavior, material balance, pressure maintenance, recovery, drop analysis	Apply cone and multiphase analysis methods to calculate oil recovery and optimal field development.

reservoir productivity.		and volumetrics to determine the productivity of the oil reservoir. Determine where to perforate production and injection wells, taking into account the degree of relationship between pressure and impermeable rocks.	Recommend when to stop production and re-completion the well.
Analysis of reservoir recovery / fluid under secondary or advanced recovery mechanisms.	Know the main mechanisms of enhanced oil recovery and be highly appreciated for their application	Understand the principles of reservoir / fluid behavior and reconstruct processes in miscible, chemical flooding, steam-based thermal and combustion processes.	Apply design process concepts (eg, profile control, pressure, temperature, fluid composition, injectivity, etc.) to calculate incremental recovery performance.
Understanding and applying processes for recovery from unconventional gas reservoirs.	Know the basic extraction processes from unconventional gas reservoirs, including shale and coal seams.	Calculate reserves and well / reservoir productivity; understand the principles of mining performance of coalbed methane.	Understand gas production analysis and water removal for coalbed methane production. Estimate the recovery of coal bed methane.
Estimating Reservoir Performance Using Reservoir Simulation	Understand and apply simulations to analyze performance and optimize field development.	Use reservoir engineering fundamentals, 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 solution, numerical analysis, vectorization, finite element / difference analysis, and parallel processing). Identify areas of the reservoir that are seized or inappropriately drained and identify new well locations with a geological entrance. Know and be able to use reservoir characterization

			software, model adaptation, and predict future results.
Understand and apply solution & risk analysis to assess distraction ratio and predict reservoir performance.	Understand the concepts of decision making and risk analysis and have an assessment of the key factors that determine the uncertainty in recovery rates and reservoir performance.	Can determine the main field development and geological and geophysical factors affecting the recovery factor, 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.
Reservoir observations	Know the basics of tank monitoring. Ability to access key information and provide ideas for improvement.	Ability to provide accurate recommendations for improving performance through re-completions, drilling new wells, spacing injection wells, etc. Develop plans and procedures for the same effect.	Develop short and long term production plans and reservoir reserves. Proactively follow well performance and provide solutions to problems.

Competence Matrix for Oil and Gas Production Technologies

SPE Task Force on Minimum Competence

Task	GENERAL KNOWLEDGE / SKILLS		
	RANGE OF MINIMUM COMPETENCE	DEPTH OF MINIMUM COMPETENCE	ABOVE MINIMUM COMPETENCE
Tubing Design for Production / Stimulation Conditions	Understand that the string is shrinking or lengthening due to changes in pressures and temperatures during stimulation and production	Can calculate precise changes in length or force of the packer due to piston effect, pipe bulging, temperature, helical twisting.	Design the same for high temperature / pressure ina corrosive environment, eg H 2S,CO 2, influence on the design.
Killing and elimination procedure	Calculate the density of the well killing fluid, show a general awareness of the need to operate safely, following company and regulatory requirements and wellbore geometry at recommended depths.	Have knowledge of the sequential steps, for example, safely erase and mount for initial operations; maintaining correct well control in all operations; the ability to correctly sequence operations with multiple stages of operations, including removing equipment and isolating the area.	Design in difficult conditions, for example, basic fishing operations, casing collapse, blowouts, swabbing.
Frac / acidizing	Know the basic gradient fracture models and key parameters. Calculate the baseline pressure drop in the system due to friction, taking into account all parameters and the treatment pressure at the bottom.	Calculate the required flow considering the pressure loss and speed limits. Modify perforation density to deliver volume at a given rate and fixed surface pressure to different zones, as well as size and strength when	Adapt additives / fluid rheology for high temperature, high pressure.

		choosing proppant. The ability to combine to incorporate the coveted P / I in design and economics.	
Overhaul procedure including pressure cementing and re-completion of the well	Understand the use of cementing data to identify problem areas, HA / WWTP for zone correlation, be able to calculate hydrostatic pressure involving two or more fluids of different densities, cement volume, pipe volume, awareness of the need to operate safely by following company and regulatory requirements and geometry wellbore at recommended depths.	Have knowledge of sequential steps such as injection schedule for choke or balanced plug. Ability to calculate the appropriate shot density / perforation size for the required production conditions.	Design pressurized cementing for gas slip or horizontal pipe replenishment of microcracks.
Nodal analysis	Knowing that the optimal production configuration is a function of the initial flow rate, wellbore pressure drops, surface conditions and wellbore configurations, it will be necessary to consider changes in reservoir behavior and changes in the composition of the produced fluid throughout the production life cycle.	The ability to design an appropriate wellbore configuration given the initial and planned inflow characteristics, surface condition, and the composition of the produced fluid.	Ability to design an appropriate wellbore configuration under surface conditions such as subsea or deepwater operations or high pressure, high temperature completions, completions with non-hydrocarbon components.
Surface equipment	Know the influence of pressure and temperature changes on the composition of the produced fluid and	Ability to design onshore equipment to separate produced fluids, process fluids to commercial quality,	Ability to design onshore equipment to separate produced fluids, process fluids to commercial quality,

	the main equipment for separating and bringing hydrocarbon to commercial quality.	and / or deliver a product for sale.	and / or deliver a product for sale.
Mechanized mining method	Know the different options to assist in lifting the produced fluids; main ranges of pressure and fluid volumes for each lift 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 surface equipment. Combine the coveted P / I in design and economics evaluation of completion / mechanized mining.	Design an appropriate production method for completing horizontal wells or severe conditions such as arctic; sea or underwater operations.
Production logging	Know the key WWTPs to ensure mechanical integrity, measure bottomhole parameters, assess hydrocarbon potential, and support bottomhole operations including completion, clean-up and disposal.	The ability to interpret and incorporate well logging data into the design and execution of operations such as completion, clean-up and abandonment for conventional oil and gas wells.	Ability to interpret and incorporate logging data into the design and execution of operations such as completion, clean-up and abandonment for horizontal, high pressure, high temperature or difficult well control situations.
Observation of prey	Know the basics of watching prey. Ability to access key information and provide ideas for improvement.	Ability to provide accurate recommendations for improving production. Develop plans and procedures for observation.	Develop short-term and long-term goals for large field assets. Proactively follow well performance and provide solutions to problems.

APPENDIX 2 - EMPLOYER REVIEWS

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

Советник директора КМГП
Доктор технических наук
профессор

А.Н. Нысангалиев

KMGP Atyrau, Republic of Kazakhstan, 97 Abylkhair Khan av. T: +7 (7122) 309120 F: +7 (7122) 763567 W: www.kmgp.k

APPENDIX 3 - REVIEW OF THE UNIVERSITY'S PARTNER

РЕЦЕНЗИЯ

на образовательную программу послевузовского обучения по специальности «Нефтегазовое дело», разработанную заведующим и преподавателями кафедры «Нефтяная инженерия» Института геологии и нефтегазового дела имени К. Турысова Казахского национального исследовательского технического университета имени К.И. Сатпаева

Образовательная программа по специальности «Нефтегазовое дело» соответствует требованиям ГОСО по специальности «Нефтегазовое дело».

В структуре и содержании программы нашли отражения современные достижения технической науки и практики нефтяного образования, а также компетентный подход к подготовке магистрантов.

При разработке образовательной программы учтены:

- ориентированность содержания подготовки выпускников на вхождение в мировое образовательное пространство;
- направленность организации технического процесса на формирование предметных и ключевых компетенций будущих специалистов по нефтегазовому делу;
- направленность научно-исследовательской деятельности в область профессиональной деятельности.

Особенностью образовательной программы является направленность ключевых компетенций на:

- углубленное знание приоритетных направлений современной образовательной политики в области нефтегазового дела;
- овладение теоретическими и методологическими основами организации учебно-образовательного процесса вуза;
- приобретение умений по использованию современных технологий при организации исследовательской деятельности в профессиональной сфере.

В образовательной программе по специальности «Нефтегазовое дело» важным является изучение:

– теоретико-методологических основ технического образования;

– методологических основ управления качеством технического образования;

– организации научно-исследовательской, экспериментально - исследовательской деятельности в процессе производственных и профессиональных практик.

Образовательная программа по специальности 6М070800/6D070800 – «Нефтегазовое дело» соответствует современным требованиям и может быть рекомендовано к утверждению и внедрению в образовательный процесс для подготовки кадров по данной специальности.

Рецензент:
Профессор кафедры бурения нефтяных
и газовых скважин Уфимского государственного
нефтяного технического университета,
доктор технических наук, Ф.А. Агзамов

14.02.2019

Подпись Агзамова Ф.А. заверяю
Начальник ОРП О.А. Дадаян