

**APPROVED at the meeting of the  
Academic Council of JSC  
"Sh. Yesenov Caspian University  
of Technology and Engineering".  
Minutes No. 09 dated May 26, 2025.**

**Entrance exam program  
for applicants for doctoral studies per group of educational programs  
D115 – «Petroleum engineering»**

1. General provisions.

1. The program was drawn up in accordance with the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 No. 600 “On Approval of the Model Rules for Admission to Education in Educational Organizations Implementing Educational Programs of Higher and Postgraduate Education” (hereinafter referred to as the Model Rules).

2. The entrance exam for doctoral studies consists of writing an essay, passing a test for readiness for doctoral studies (hereinafter referred to as TRDS), an exam in the profile of a group of educational programs and an interview.

<b>Block</b>	<b>Points</b>
1. Interview with the applicant conducted by the admissions examination committee of the higher education institution	30
2. Essay	20
3 Exam in the specialty of the educational program group	50
<b>Total</b>	<b>100</b>

3. The duration of the entrance examination is 3 hours and 30 minutes, during which the applicant undergoes an interview, writes an essay, and responds to an electronic examination ticket. The interview is conducted at the higher education institution prior to the entrance examination.

2. Procedure for the entrance examination.

1. Applicants to the doctoral program group D115 – «Petroleum engineering» must write a problem-oriented / thematic essay. The essay should be at least 250-300 words long.

2. The electronic exam ticket consists of 3 questions.

Topics for exam preparation according to the profile of the group of the educational program.

Discipline: «**Innovative research methods and commercialization**»

### **1. Basic Concepts of Science and Commercialization of Developments**

Concept of science and scientific activity - science is considered as a system of knowledge and a type of activity aimed at obtaining new objective knowledge about nature, society, and technologies. Results of scientific research - new knowledge, technologies, and methods that may have both theoretical and practical value. Commercialization of developments - the process of transforming scientific results into a product or service that generates economic benefit. Link between science and the market - scientific developments gain value only when they are demanded by the market and implemented in production.

### **2. Science and Business: Mutual Expectations and Interests**

The role of science in business development – science provides technological solutions that enhance the competitiveness of companies. Business expectations – fast, practice-oriented solutions with minimal risks. Science expectations – funding, access to data, and opportunities for implementation of results. Interaction challenges – differences in goals, timelines, and approaches between scientific and commercial environments.

### **3. Basic Concepts of Innovation Activity**

Innovation – an implemented novelty that creates economic or social effect. Innovation process – a sequence of actions from idea to implementation. Innovation actors – scientists, companies, government, investors. Innovation infrastructure - techno parks, business incubators, venture funds.

### **4. Types of Innovations**

Product innovations – creation of new or improved goods. Process innovations – new production technologies. Organizational innovations – changes in management and business processes. Marketing innovations – new methods of promotion and sales.

### **5. Market Pull Innovation Model**

Essence of the approach – innovations are driven by market needs. Role of the consumer – a key factor in determining the direction of development. Marketing research – a tool for identifying demand. Advantages and limitations – high probability of success but limited radical innovations.

### **6. Technology Push Innovation Model**

Essence of the approach – innovations arise from scientific discoveries. Role of science – generation of new technologies *независимо* of current demand. Commercialization – searching for markets for already developed technologies. Risks – possible lack of demand for innovation.

### **7. Stages of Commercialization of Research and Development Results**

Idea generation – emergence of a scientific or technical development. Development and prototyping – creation of a prototype. Testing – verification of efficiency and safety. Market entry – product launch. Scaling – expansion of production and sales.

### **8. Stages of the Innovation Cycle**

Idea generation – search for new solutions and technologies. Development – scientific and technical elaboration. Implementation – practical application. Diffusion of innovations – spread in the market. Replacement – obsolescence and substitution by new technologies.

### **9. Research and Development results as a Basis of Intellectual Property**

Types of Research and Development results – inventions, utility models, software. Patentability – novelty, inventive step, industrial applicability. Documentation – formalization of scientific results. Transition to IP – legal protection of rights.

### **10. Intellectual Property as an Asset**

Concept of IP – an intangible asset with economic value. Legal protection – patents, copyrights. IP management – accounting, protection, and use. Commercial application – licensing, sale of rights.

### **11. Evaluation of Commercial Potential of a Development**

Technology Readiness Level (TRL) – level of technological maturity. Market analysis – demand, competitors, customers. Economic efficiency – expected profit. Risks – technological and market uncertainties.

### **12. Marketing of Innovations and Development Trajectories**

Features of innovation marketing – high market uncertainty. Product life cycle – from introduction to decline. Technology trajectories – directions of technological development. Promotion strategies – market entry and positioning.

### **13. Partner Search for Promotion of R&D Results**

Types of partners – investors, corporations, research centers. Networking – establishing professional connections. Collaboration platforms – clusters, techno parks. Contractual relations – partnership agreements.

### **14. Problems of Commercialization in Kazakhstan and Solutions**

Main barriers – weak link between science and business. Financial constraints – lack of investment. Institutional problems – imperfect support mechanisms. Solutions – development of innovation infrastructure and state support.

### **15. Commercialization of Scientific and Technical Activities**

Commercialization models – licensing, startups. Technology transfer – transfer of developments to industry. Creation of spin-off companies – bringing technologies to market. Economic impact – contribution to economic development.

### **List of References**

1. Rogers E.M. *Diffusion of Innovations*. — Free Press, 2003.
2. Schumpeter J.A. *The Theory of Economic Development*. — Harvard University Press, 1934.
3. Christensen C.M. *The Innovator's Dilemma*. — Harvard Business Review Press, 1997.
4. Tidd J., Bessant J. *Managing Innovation: Integrating Technological, Market and Organizational Change*. — Wiley, 2018.
5. Osterwalder A., Pigneur Y. *Business Model Generation*. — Wiley, 2010.
6. Etzkowitz H., Leydesdorff L. *The Triple Helix: University–Industry–Government Relations*. — Science and Public Policy, 2000.
7. OECD. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. — OECD Publishing, 2018.
8. Porter M.E. *Competitive Advantage*. — Free Press, 1985.
9. Blank S., Dorf B. *The Startup Owner's Manual*. — K&S Ranch, 2012.
10. World Intellectual Property Organization (WIPO) reports on technology transfer and commercialization.

## **Discipline "Limitation of water flows into wells"**

### **Topic 1. Geological and technical factors affecting well flooding.**

A sub-topic. The geological structure of the deposit and its effect on flooding. Types of collectors and their role in water supply. The presence of tectonic disturbances. Oil-water contacts and their dynamics. Technical condition of the casing.

### **Topic 2. The material composition of oil-bearing formations. Heterogeneity of the pore space.**

A sub-topic. Mineralogical composition of rocks. Clay content and its effect on filtration. Types of pore space. Porosity and permeability. Capillary properties of rocks. Microuniformity of reservoirs.

### **Topic 3. Heterogeneity of oil-bearing formations.**

A sub-topic. Vertical heterogeneity. Lateral heterogeneity. Facies variability. Layering. Coefficient of heterogeneity. Impact on development.

### **Topic 4. Properties of oil. Pressure and temperature. The technical condition of the well.**

A sub-topic. Physico-chemical properties of oil. Viscosity. Density. Gas content. Reservoir pressure. Temperature. The technical condition of the well.

### **Topic 5. The condition of the bottom-hole zone of the reservoir. The nature and mode of flooding.**

A sub-topic. The bottom-hole zone of the reservoir. Contamination of manpads. The skin factor. Types of flooding. Contour flooding. Intracircular flooding. Uneven displacement.

### **Topic 6. Causes of well flooding. Waters of oil fields. Properties of waters of oil fields.**

A sub-topic. Causes of flooding. Types of reservoir waters. Mineralization. Properties of waters. Compatibility of waters. The effect of water on prey.

### **Topic 7. Causes of well flooding. Sources of flooding.**

A sub-topic. Plantar water. Marginal waters. Injected water. Column overflows. Cracks. Man-made causes.

### **Topic 8. Technical methods for determining the source of well flooding. Geophysical methods for determining the source of well flooding.**

**A sub-topic.** Technical methods. Geophysical Research (GIS). Thermometry. Radioactive methods. Tracer methods. Interpretation.

### **Topic 9. Definition of flooded strata. Detection of column overflows of liquid**

**A sub-topic.** Determination of waterlogged intervals. Logging. Acoustic methods. Column overflows. Inflow profiles. The tightness of the columns.

### **Topic 10. Selective methods of limiting water inflow. Classification of methods for limiting water flow.**

**A sub-topic.** Classification of methods. Selective methods. Non-selective methods. Chemical methods. Mechanical methods. Combined technologies.

### **Topic 11. Polymer flooding.**

**A sub-topic.** The basics of polymer flooding. Types of polymers. The mechanism of displacement. Selection of polymers. Download parameters. Effectiveness.

**Topic 12. Polymer-dispersed systems. Polymer gel systems.**

**A sub-topic.** Polymer-dispersed systems. Polymer gel systems. The mechanism of gelation. Rheological properties. Terms of use. Effectiveness.

**Topic 13. Limitation of water supply using rubber chips. Curing chemicals. Oil-acid systems.**

**A sub-topic.** A rubber crumb. Curing reagents. Oil-acid systems; Isolation mechanism. Download technology. Limitations.

**Topic 14. Reverse emulsions. Organosilicon compounds.**

**A sub-topic.** Reverse emulsions. Properties of the emulsion. Organosilicon compounds. Hydrophobizers. Technology of application. Effectiveness.

**Topic 15. Hydrophobization of the rock surface of the bottom-hole zone of the formation. Inorganic waterproofing materials. Foam systems.**

**A sub-topic.** Hydrophobization of PP. Inorganic materials. Foam systems. The mechanism of action. Processing technologies. Evaluation of effectiveness.

**List of literature**

1. M.T. Abasov, A.S. Strekov, G.M. Efendiev "Improving the efficiency of limiting water flows in oil wells", Baku "Nafta-Press", 2010. [www.sciencedirect.com](http://www.sciencedirect.com)
2. Sadueva G.K. "Limiting water flows into wells" Electronic resource., Aktau: KGUTI. 2018.
3. Bayamirova R.U. "Increasing the productivity of producing and receiving injection wells at the field", Monograph- Almaty: Lantar books. 2024-148C.
1. E.K. Akynbekov, A.E. Akynbekov, K.S. Nadirov Modern methods of increasing oil recovery. The training manual.
2. Nurumova S.J. "Improving the effectiveness of methods for increasing oil recovery" Methodological guidelines for practical exercises", Aktau: KGUTI, 2015-28C.
3. Antoniadi, Gaponenko, Vartumyan "Modern technologies for intensifying production of high-viscosity oil and evaluating the effectiveness of their use"; Erudite 2019
4. Streltsova Yu.G., Vartumyan G.T. "Modern technologies for the intensification of high-viscosity oil production and evaluation of the effectiveness of their application" Infra-engineering. 2019

Discipline «**Development of marine deposits**»

**Topic 1. Introduction. Brief Analysis of Offshore Field Development Worldwide and in Kazakhstan**

**Subtopics:** Current state and prospects of offshore oil and gas production worldwide and in Kazakhstan. Development of discovered offshore hydrocarbon fields in the Asia-Pacific region.

**Topic 2. Classification of Technical Facilities for Offshore Oil and Gas Field Development**

**Subtopics:** Complex of technical facilities for offshore oil and gas field development. Classification of types of foundations and installations for drilling offshore areas.

**Topic 3. Drilling Vessels and Barges**

**Subtopics:** Types and designs of drilling vessels. Description of the drilling barge "Sunkar." Moored floating drilling barge.

**Topic 4. Offshore Field Development**

**Subtopics:** Stages of offshore field development design. Well clustering options at offshore fields. Offshore development technologies. Evaluation of reservoir sweep efficiency during displacement processes.

**Topic 5. Reservoir Drive Mechanisms in Offshore Fields**

**Subtopics:** Sources and characteristics of reservoir energy. Types of reservoir drive mechanisms in offshore fields. Enhanced oil recovery (EOR) methods.

**Topic 6. Well Placement in the Field and Selection of Perforation Intervals**

**Subtopics:** Well layout schemes for wells drilled and operated from offshore platforms. Uniform and non-uniform well patterns. Typical values of well spacing density parameters.

**Topic 7. Equipment and Technology for Offshore Drilling**

**Subtopics:** Offshore drilling conditions. Factors affecting the efficiency of offshore drilling. Requirements for drilling offshore exploration wells. Specific features of offshore drilling.

**Topic 8. Well Clustering Systems and Equipment Arrangement on Offshore Platforms**

**Subtopics:** Methods of wellhead placement during drilling. Arrangement of dual-bore wells on platforms. Four-bore well clustering systems.

**Topic 9. Types of Wellhead Equipment**

**Subtopics:** Above-water wellhead arrangement without support on a platform. Purpose of wellhead equipment. Subsea wellhead equipment for offshore wells. Advantages and disadvantages of different types of wellhead equipment.

**Topic 10. Operation of Offshore Oil Fields**

**Subtopics:** Preparation for offshore well commissioning. Options for connecting wellhead equipment of flowing wells. Application of rodless pumping units. Hydraulic piston lift method for offshore well operation. Progressive cavity pumps and jet pump installations. Tandem pumping systems.

**Topic 11. Processing of Well Production Offshore**

**Subtopics:** Technological processes of oil and gas treatment performed on platforms. Oil treatment flow schemes on offshore platforms.

**Topic 12. Gas Gathering and Treatment Systems**

**Subtopics:** Basic block diagram of gas well production gathering. Principal process flow diagrams for offshore gas and condensate treatment. Gas treatment with methanol injection. Gas dehydration using glycol.

**Topic 13. Transportation and Storage of Well Production Offshore**

**Subtopics:** Methods of pipeline installation. Pipe-laying vessels and equipment. Aerial transportation systems. Oil storage under offshore conditions. Subsea oil storage tanks.

**Topic 14. Environmental Protection at Offshore Fields**

**Subtopics:** Types of environmental pollution sources. Process flow diagram of the "Flying Flame" installation by Baker. Waste products from oil and gas wells and their disposal. Containment and elimination of oil and petroleum products from the water surface.

**Topic 15. Hydraulic Engineering Structures in the Form of Artificial Islands**

**Subtopics:** Construction of reclaimed artificial islands. Advantages and disadvantages of using artificial islands. Artificial island structures with concrete slope protection.

Reference

1. Allen P.A., Allen J.R. *Basin Analysis: Principles and Applications*. - Wiley-Blackwell, 2013.
2. Nichols G. *Sedimentology and Stratigraphy*. - Wiley-Blackwell, 2009.
3. Reading H.G. *Sedimentary Environments: Processes, Facies and Stratigraphy*. - Blackwell Science, 1996.
4. Boggs S. *Principles of Sedimentology and Stratigraphy*. - Pearson, 2011.
5. Selley R.C. *Elements of Petroleum Geology*. - Academic Press, 2015.
6. Magoon L.B., Dow W.G. *The Petroleum System: From Source to Trap*. - AAPG Memoir 60, 1994.
7. Tissot B.P., Welte D.H. *Petroleum Formation and Occurrence*. - Springer, 1984.
8. Emery K.O., Myers W.A. *Geology of the Continental Margin*. - Springer, 1972.
9. Kennett J.P. *Marine Geology*. - Prentice Hall, 1982.
10. UNESCO/IOC reports on marine sedimentary basins and offshore resource development.