Ministry of Science and Higher Education of the Russian Federation
Federal State Autonomous Institution of Higher Education
Kazan Federal University

APPROVE

First vice-rector –
vice-rector for Science

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« 15 » January 2026

Specialty entrance examination program

Level of higher education: training of highly qualified personnel
Educational program type: program for the training of scientific and scientific-pedagogical personnel in graduate school
Scientific specialty: 2.8.4 Petroleum Engineering
Form of study: full-time

2026

General instructions

Entrance examinations in the scientific specialty 2.8.4 Petroleum Engineering covers the standard sections of university courses on the development of oil and gas fields, well operation, reservoir physics.

The questions and the structure of the exam papers are given below.

The procedure for conducting entrance examinations

The exam is administered in the form of a ticket-based exam. Each exam ticket contains 2 questions. The exam is in written form. Preparation for the answer is 1 academic hour (60 minutes) without a break from the moment the ticket is distributed. Tasks are evaluated from 0 to 100 points depending on the completeness and correctness of the answer.

Evaluation criteria

An applicant will be graded for the exam according to the following criteria.

Excellent (80-100 points)

The applicant confirmed the comprehensive, systematic and deep knowledge of the material, the ability to freely perform tasks, mastered the basic literature and is familiar with the additional literature recommended by this program, mastered the relationship between the main processes of field development between themselves and related fields of science, the principles of regulation of field development , in their meaning for acquired profession, showed creative abilities in understanding, presentation and use of educational and program material.

Good (60-79 points)

The applicant confirmed full knowledge of the issues of oil and gas field development, showed the systematic nature of knowledge on the principles of managing the development of oil and gas fields using modern scientific achievements and is able to independently replenish and update them in the course of further educational work and professional activities.

Satisfactory (40-59 points)

The applicant has confirmed knowledge of the development of oil and gas fields to the extent necessary for further studies and future work in the profession, is familiar with the basic literature recommended by this program, made errors in the answer to the exam and when performing examination tasks, but has the necessary knowledge to eliminate them under teacher guidance.

Unsatisfactory (less than 40 points)

The applicant showed significant gaps in knowledge of the fundamentals of reservoir physics, underground hydromechanics, development and operation of oil and gas fields, and the inability to continue education in the specialty.

The list of questions for post-graduate entrance exam in the scientific specialty 2.8.4 Petroleum Engineering

Development of oil and gas fields

1. Oil recovery factor and factors influencing the design oil recovery factor.
2. The concept of well grid density. Influence of well spacing density on oil recovery factor.

3. Development object. Conditions for selecting development objects. Principles of combining layers into a single development object.
4. Classification of development systems. Indicators characterizing development systems.
5. Technological indicators of development. Dynamics of technological development indicators. Determination of the reservoir operation mode according to the dynamics of technological development indicators.
6. Layer models. Probabilistic-statistical and deterministic reservoir models.
7. The manifestation of elastic forces in the development of hydrocarbon deposits. Conditions for the existence of an isolated elastic regime of reservoir operation. Resilience coefficient of the formation.
8. Description of the principles of in-contour waterflooding. Selective, barrier, block and other types of flooding.
9. Reservoir pressure characteristic. Influence of reservoir pressure dynamics on field operation modes. Influence of formation pressure change on oil mobility.
10. Basic laws of filtration in porous media. Conservation laws in modeling field development.
11. The concept of heat and mass transfer in porous media when modeling displacement processes.
12. Characteristics of the model of piston displacement of oil by water. Principal features of the use of the piston displacement model in layered heterogeneous reservoirs
13. Characteristics of the non-piston displacement model. Phase permeabilities and the Buckley-Leverett function in the description of non-piston displacement processes.
14. Theoretical foundations for the use of thermal methods of influencing reservoirs. Principles of calculation of thermal impact on formations.
15. Theoretical Foundations of the Application of Polymer Flooding. Types and varieties of polymer flooding. Technological Limitations of the Applicability of Polymer Flooding Technologies. degradation of polymers.
16. Theoretical Foundations of the Application of Alkaline Flooding. Acid number for oil. The concept of adsorption and desorption of surfactants.
17. capillary pressure. Hydrophobic and hydrophilic collector. Factors determining displacement conditions in hydrophobic and hydrophilic reservoirs. Possibilities of rock wettability control.
18. Theoretical foundations for the use of surfactant flooding. The use of alkaline flooding surfactants are the main theoretical aspects and principles of application.
19. Theoretical aspects of the application of technologies for in-situ oil oxidation for the development of deposits of hard -to-recover reserves. Varieties of in-situ oil oxidation. Temperature regime of oxidative in-situ processes and displacement mechanism.
20. Classification of methods for enhanced oil recovery. EOR and IOR. Primary, secondary and tertiary methods for enhanced oil recovery.
21. Principles and theoretical foundations for the use of technologies of secondary methods for increasing oil recovery. Hydrodynamic methods of PNP. Theoretical foundations and principles of application of cyclic waterflooding, non-stationary filtration, transfer of the injection front.
22. Microbiological impact during the implementation of enhanced oil recovery technologies. Injection of metabolic products to increase oil recovery factor. Formation of reservoir environment for oil conversion in reservoir conditions.

23. Principles for calculating the technological efficiency of enhanced oil recovery measures. The concept of displacement characteristics. Principles of forecasting technological indicators of development based on displacement characteristics.
24. Organization of the RPM system based on the principles of “smart” water injection. Influence of salinity of injected waters on displacement capacity. Surface tension at the interface between the displaced, displacing agent and the rock.
25. Technological bases for the forecast of technological indicators of development. Principles of modeling development processes and designing the result of the applicability of EOR methods.
26. Stock classification. Stock categories. Principles of calculation of stocks. Reserves classification principles. Difference between Russian and foreign classification of reserves.
27. Features of the development of gas fields. Cycling process in the development of gas fields.
28. gas hydrate deposits. Features of the formation of gas hydrate deposits and the principles of their development.
29. Development of hydrocarbon deposits using horizontal and multilateral wells. Principles for calculating the flow rate of horizontal wells. Formulas of Borisov, Joshi, Jiger , etc. for calculating the flow rates of horizontal wells.
30. Application of technologies for gas treatment of reservoirs. Theoretical foundations for the use of CO_2, N_2, hydrocarbon gas, air for oil displacement. Technological basis for the application of technology « huff and puff ".

Well operation and stimulation

1. The concept of mode. Well operation mode control. The main characteristics of the well operation mode.
2. Basic principles of well operation. Influx equation. Factors that determine the potential of a well. Dynamic and static well level.
3. Principles of well productivity management. The concept of the skin effect. Influence of bottomhole zone properties on productivity.
4. Well Investigation Methods in Non-Stationary Filtration Mode. Principles of data processing Efficiency, KVU, KVD. Horner and Mneev 's methods for calculation of filtration characteristics of formations.
5. Well Investigation Methods in Stationary Filtration Mode. Curvature of indicator diagrams, causes of curvature. Optimization of well operation mode according to indicator diagrams.
6. Acid treatment of terrigenous reservoirs. Principles of selection of technological solutions for the BHT of a terrigenous reservoir. The choice of acid treatment components depending on the mineral composition of the rocks.
7. Acid treatment of carbonate reservoirs. Main varieties. Components of acid compositions to eliminate the risks of loss of productivity during acid treatments.
8. Types of acid treatments. The choice of technologies for acid treatment of wells.
9. Varieties of technology application « huff and puff » to intensify the flow of fluid.
10. Hydraulic fracturing in terrigenous deposits. Characteristics of the process and the main process fluids during hydraulic fracturing. proppant requirements.

11. Hydraulic fracturing in horizontal wells. Direction of fractures, features of implementation, principles and approaches in the implementation of multi-stage hydraulic fracturing.
12. Hydraulic fracturing in carbonate deposits. Acid hydraulic fracturing. Principles and Applicability Characteristics of Acid Fracturing.
13. Fundamentals of the theory of hydraulic fracturing. Geomechanics of the hydraulic fracturing process. The concept of crack half-length, crack opening. The concept of hydraulic fracturing design.
14. Secondary opening of layers. Cumulative and non-cumulative methods of secondary opening of reservoirs.
15. Well completion principles. Completion of horizontal and vertical wells advantages and disadvantages of various well completion schemes. TAML classification.
16. Application of multilateral wells. fish type wells bone advantages and disadvantages of multilateral wells. Methods for completing the MZGS.
17. The use of solvents for stimulation. Principles and approaches in the implementation of technology for the use of solvents. Technologies VAPEX, hermal solvent, N -solv , Savex .
18. The use of TCF. Varieties of technology for the use of thermal gas chemical exposure. The use of binary systems for the implementation of TCF.
19. Production stimulation technologies implemented in horizontal wells. Principal features and characteristics of the execution process.
20. Physical methods of influencing the bottomhole zone of wells. Acoustic and wave impact technologies. Application of injector and jet pumps for intensification of inflow.
21. Well development. Well development methods. Technical and technological limitations in the development of wells.
22. Characteristics of well operation methods. Selection and justification of the well operation method. The method of expert assessments when choosing a method of operation. The concept of the pump flow rate.
23. Complications in the operation of wells. Reasons for the formation of complications and monitoring of the operation of wells to assess the factors and causes of complications. Formation of ASPO, emulsions, salts, fur impurities, etc. during well operation.
24. The main operational characteristics of the reliability of well operation. The concept of MCI, operation coefficient, frequently repaired fund, premature repair, time between failures. Principles of organization of underground current workover of wells
25. Accounting and control of the operation mode of wells. Characteristics of the operation of controllers for the operation of wells equipped with USP. Principles of control of operation of wells equipped with ESP. The use of REP in the operation of wells equipped with ESP.
26. Control of the technical condition of wells. Ensuring control of the technical condition of wells in accordance with the requirements of the field development rules. The main characteristics of the well design.
27. Principles of calculation of pressure distribution along the vertical wellbore. Application of data on the distribution of pressure along the wellbore to select the method of operation and the depth of the pump descent.
28. Exploitation of gas wells. Principles of combating the formation of gas hydrates during well operation. Methods for the removal of associated fluid during gas lift operation.

29. Conditions of gas inflow into wells. Equation of gas inflow to the bottom of a gas well. Operation of a gas well.
30. Intensification of gas wells. Technological solutions and features of technology implementation. Foam systems for the intensification of gas wells.

Methodological and informational materials for the program of post-graduate entrance exam in the scientific specialty 2.8.4 Petroleum Engineering

1. Zheltov Yu.P. Development of oil fields. Textbook Nedra, Moscow, 1998, 365 pages. https://www.geokniga.org/books/10467
2. Ibatullin , Ravil Rustamovich. Technological processes for the development of oil fields [Text]: a textbook for students of higher educational institutions studying in the direction of master's training 131000 "Oil and Gas Business" / R. R. Ibatullin . - Moscow: VNIIOENG, 2011. - 303 p.: ill., tsv. ill., tab.; 22 cm - (Tatneft).; ISBN 978-5-88595-170-8 (in translation) https://www.geokniga.org/bookfiles/geokniga-tehnologicheskie-processy-razrabotki-neftyanyh-mestorozhdeniy.pdf
3. E.A. Gladkov Geological and hydrodynamic modeling of oil and gas fields: textbook / E.A. Gladkov; Tomsk Polytechnic University. - Tomsk: Publishing House of Tomsk Polytechnic University, 2012. - 99 p. Text: electronic. - URL: https://portal.tpu.ru/SHARED/g/GLADKOVEA/Uchebnaya/Tab4/GLADKOV_3D_MODELING.pdf
4. M. A. Kornilina , E. A. Samarskaya, B. N. Chetverushkin , N. G. Churbanova , M. V. Yakobovsky, Simulation of oil field development on parallel computing systems, Matem . modeling, 1995, volume 7, number 2, 35–48 Text: electronic. - URL: http://www.mathnet.ru/links/f0db79f3f05494dcfeb8e96214665f24/mm1665.pdf
5. Sokolov, V.S. C594 Modeling of development of oil and gas fields: study guide / V.S. Sokolov. - Tyumen: TyumGNGU, 2014. - 146 p. ISBN 978-5-9961-1008-7 Text: electronic. - URL: http://elib.tyuiu.ru/wp-content/uploads/2015/03/12-32_21.pdf
6. A. K. Yagafarov, I. I. Kleshchenko, G. P. Zozulya , Yu . I. I. Kleshchenko, G. P. Zozulya and others. - Tyumen: Tsogu, 2010. - 396 p. ISBN 978-5-9961-0326-3 Text: electronic. - URL: http://elib.tyuiu.ru/wp-content/uploads/2011/05/%D0%A0%D0%B0%D0%B7%D1%80%D0%B0%D0%B1%D0%BE%D1%82%D0%BA%D0%B0_%D0%BD%D0%B5%D1%84%D1%82%D1%8F%D0%BD%D1%8B%D1%85_%D0%B8_%D0%B3%D0%B0%D0%B7%D0%BE%D0%B2%D1%8B%D1%85.pdf
7. Zimina S.V., Pulkina N.E. Geological foundations for the development of oil and gas fields . TPU, Tomsk, 2011, 203 pp. https://www.geokniga.org/books/17573 .
8. Koskov V.N., Khizhnyak G.P., Yushkov I.R. Field and geophysical characteristics of wastewater disposal facilities in the development of oil and gas fields Perm National Research Polytechnic University, Perm, 2015, 102 pages https://www.geokniga.org/books/14832 .