


Application 3

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KARAGANDA TECHNICAL UNIVERSITY  
NAMED AFTER ABYLKAS SAGINOV

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**THE PROGRAM  
OF THE ENTRANCE EXAM**  
for admission to the doctoral program  
Educational program 8D07202 – «Mining»

Department: Development of mineral deposits

Developed:  
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## Preface

The program of the entrance exam for the educational program has been developed:

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Discussed at the meeting of the DMD Department  
Protocol № \_\_\_\_\_ от «\_\_\_\_» \_\_\_\_\_ 20\_\_\_\_ .

Head of the Department \_\_\_\_\_ Imashev A.J. « \_\_\_\_ » \_\_\_\_\_ 20\_\_\_\_ .  
(signature) (Full name)

The list of subjects of the entrance exam according to the educational program  
8D07202 - MINING

№	Name of the discipline	Number of questions	Страницы
1	Organization of scientific research and innovation activities	20	3
2	Practical geomechanics	30	4
3	Modern problems in mining	25	5

The exam is conducted in writing. The exam ticket contains 3 questions in different disciplines.

**1 «Organization of scientific research and innovation activities»**

**The content of the discipline**

**1.1 General information about scientific research (Research work)**

Basic definitions and concepts of scientific research.

Classification of research and development according to various criteria: types of links with production, degree of importance, sources of financing, duration of development, purpose, etc.

Stages of the process of performing theoretical and applied research: formulation of the topic, goals and objectives of the study, theoretical and experimental research, analysis and design of scientific research, implementation and economic efficiency

Scientific institutions and training of scientific personnel. The National Academy of Sciences and academic institutes, branch institutes, universities. Master's, postgraduate and doctoral studies.

The role of scientific and technical information in the formulation of research topics. Media. Information flows. Information storage. The main methods and methods of information retrieval. Sources of information. Conditions for effective document processing. Work on the book. Extracts, abstracts, summaries and reviews. Conclusions based on the analysis of information.

**1.2 Theory and practice of the experiment**

Methodology of theoretical research: deduction and induction, analysis and synthesis, ranking, abstraction and formalization.

Classical methods of studying functions at the extremum.

Linear programming: problem statement, graphical solution method, distributive method. Transport task: task formation, open and closed tasks, methods of finding a basic solution, the method of potentials. Integer linear programming problems. Application of linear programming methods in mining.

General concepts of nonlinear programming: economic and geometric interpretation of nonlinear programming problems, convex programming problems, gradient solution methods.

General concepts of dynamic programming: general characteristics of tasks, their economic and geometric interpretation, methods of step-by-step problem solving, the principle of optimality.

The methodology of the experiment. Development of an experimental plan-program. Measuring instruments. The main provisions of the theory of experiment planning, justification of the necessary and sufficient number of repetitions of the experiment.

Processing of measurement results: fundamentals of mathematical statistics, theoretical and statistical distributions of random variables, histogram, polygon, confidence interval and confidence probability.

Selection of empirical dependencies by methods: stretched thread, average, least squares.

### **1.3 General information about the theory of innovation**

The general scheme of development of technical systems. The connection of cyclical processes of the economy with the development of technology and technology. The main provisions of the theory of long waves. General characteristics of innovation processes: technical and technological innovations, organizational, managerial and economic innovations, social, legal and environmental innovations. Innovative processes in enterprises. Evaluation of the effectiveness of innovations.

#### **Recommended literature**

1 Ludchenko A.A., Ludchenko Ya.A., Primak T.A. Fundamentals of scientific research: textbook. stipend / Edited by A.A. Ludchenko. – 2nd ed., revised. – Kiev: O-vo "Knowledge", KOO, 2001. – 113 p.

2 Scientific problems of mining production: collection of articles / Edited by V.V. Istomin. – M.: MGSU, 2000. – 355 p.

3 Wentzel E. S. Probability theory. – M.: ACADEMIA, 2003. – 572 p.

4 Hemdi A. Taha Introduction to operations Research - Operations Research: An Introduction. — M.: Williams, 2007. — 912 p.

5 Grachev Yu.P. and Plaksin Yu.M. Mathematical methods of experiment planning. – M.: Higher. education, 2005. – 296 p.

6 Aleksakhin S.V. Applied statistical analysis: a textbook for universities. – M.: PRIOR, 2001. – 224 p.

7 Blinnikov V.I. Patent: from idea to profit. – M.: Mir, 2002. – 333 p.

## **2 «Practical geomechanics»**

### **The content of the discipline**

#### **2.1 Basic concepts of mountain pressure**

Mountain pressure. The manifestation of mountain pressure. Displacements of the rock mass. Discharge zones and stress concentrations. Forms of manifestation of mountain pressure. Mountain pressure control. Classification of ores and rocks according to the degree of stability. The main properties of the array and its model. Fracturing of the array. Uniformity and heterogeneity of the array.

#### **2.2 The natural stress state of the rock mass**

Horizontal and vertical stresses in the array. The coefficient of lateral pressure. Gravitational stress state. Horizontal tectonic stress state. Hydrostatic stress state. The stress state and displacement of the array around the workings. Forms of destruction of mine workings. The basic principles of ensuring the sustainability of workings. Categories of rock stability.

### **2.3 Fixing of preparatory workings**

The main types of support. Shotcrete is a concrete support. Anchorage. Metal frame support. Combined support. Choosing the type of support. Foreign experience in assessing the stability of workings and choosing the type of support. Rating classifications of the rock mass.

### **2.4 Mountain Bumps**

Basic concepts and definitions. Dynamic manifestations of mountain pressure. Conditions of occurrence of fire-hazardous situations. The forecast of the impact hazard of sections of the rock mass. Measures to reduce the impact hazard of workings.

### **2.5 Mountain pressure management**

Management of rock pressure in the development of shallow and inclined deposits. The principle of mountain pressure control. Principles of determining the load on the targets. The stressed state and strength of the tselikov. Management of rock pressure during the re-development of shallow deposits. Maintenance of the developed space by ore columns.

### **Recommended literature**

1. Baklashov I.V. Geomechanics: textbook for universities / in 2 vols. Fundamentals of geomechanics. – M.: MGGI Publishing House, 2004. - Vol. 1. - 208 p.
2. Protosenya A.G., Timofeev O.V. Geomechanics. - St. Petersburg: St. Petersburg State Mining Institute, 2008. - 117 p.
3. Baklashov I.V., Kartoziya B.A., Shashenko A.N., Barisov V.N. Geomechanics: textbook for universities / in 2 volumes. Geomechanical processes. – M.: Publishing House of MGGI, 2004. - Vol. 2. – 249 p.
4. Makarov A.B. Practical geomechanics: a manual for mining engineers. – M.: Publishing house "Gornaya kniga", 2006. - 391 p.
5. Olovyanny A.G. Some problems of mechanics of rock masses. – St. Petersburg: FSUE "Multiplying Scientific Center" VNIMI, 2003. - 234 p.
6. Kazikaev D.M. Geomechanics of underground ore mining. - M.: Publishing House of Moscow State University, 2005. - 542 p.
7. Pevsner M.E., Iosif M.A., Popov V.N. Geomechanics. – M.: Publishing House of Moscow State University, 2008. – 438 p.
8. Hoek E. Practical Rock Engineering. – Vancouver, 2007. – 237 p.
9. Tsai B.N. Thermal activation nature of rock strength. -Karaganda: KarSTU, 2007. – 235 p.
10. Brady B.H., Brown E.T. Rock mechanics for underground mining. – Dordrecht.: Springer, 2005. – 628 p.

11. Trushko V.L., Protosenya A.G., Matveev P.F., Sovmen H.M. Geomechanics of massifs and dynamics of deep mine workings. - St. Petersburg: St. Petersburg Mining Institute, 2000. - 396 p.

### **3 «Modern problems in mining»**

#### **Content of the discipline:**

#### **3.1 Combined geotechnology**

The essence and current state of the combined technology. Conditions of application and design of the combined technology. Development of reserves of transition zones with combined technology. Substantiation of the main parameters of the combined technology. The main problems of effective application and development of combined technology. Evaluation of the effectiveness and justification of the field of rational use of combined technology.

#### **3.2 Problems of development of mineral deposits**

New promising technologies in the complex development of ore deposits. Re-development of deposits. Formation of the basic principles for the creation of low-waste technologies. Studies of the interaction of man-made spaces created with an array of rocks. Development systems that ensure the completeness of the extraction of mineral reserves. The influence of the main mining and geological and mining engineering conditions of development on the stability of man-made spaces.

#### **3.3 Modern problems of geomechanics and rock destruction**

The main provisions and the history of the development of geomechanics. Priority and new scientific directions in geomechanics. Objects and tasks of geomechanics research. Modern problems in the field of rock destruction. The development of scientific knowledge and practice in the field of rock destruction. The object of research and tasks in the field of rock destruction.

#### **3.4 Modern problems and prospects of mining production**

Modern problems of underground mining. Modern problems of open-pit mining. Modern problems of maintaining mine workings. Problems of mine ventilation and ensuring the safety of mining operations. Training of personnel for mining enterprises. Geoinformation systems in mining. Problems of numerical modeling of geomechanical processes.

#### **Recommended literature**

1. Combined geotechnology / D.R. Kaplunov, V.N. Kalmykov, M.V. Rylnikova. – M. : Ore and metals, 2003. – 260 p.

2. Geotechnological methods of field development / L.A. Puchkov, I.I. Sharovar, V.G. Vitkalov. – M.: Gornaya kniga, 2006. – 322 p.

3. Lazchenko K.N. Geotechnological methods of mining mineral deposits: a textbook / K.N. Lazchenko. – M.: Publishing House of Moscow State University, 2007. – 244 p.

4. Complex development of natural and man-made mineral resources. Monograph / B.T. Berkaliev, B.J. Khamimolda, R.K. Komarov. – Karaganda: 2007. – 160 p.

5. Andreiko S.S. Modern problems of science and production in the field of mining: studies. stipend. – Perm: Publishing House of Perm State Technical University. unita, 2010. – 338 p.

Reviewed at the meeting of the DMD Department

#### **4 Materials for the doctoral entrance exams**

##### **4.1 Questions for the entrance exam**

###### **4.1.1 Organization of scientific research and innovation activities**

1. Science in modern life.
2. The scheme of science development.
3. The main patterns of the development of science.
4. Basic definitions and concepts of science.
5. Classification of research. Stages of research.
6. Scientific institutions.
7. Scientific and technical information.
8. Information search, elaboration and analysis of information.
9. Methodology of theoretical research.
10. General theoretical research methods and their fields of application.
11. Classical methods of extremum function research.
12. The study of the functions of one variable, the study of the functions of several variables.
13. The method of indefinite Lagrange multipliers.
14. The essence of linear programming.
15. Formulation of the linear programming problem.
16. Types of linear programming problems and ways to solve them.
17. A graphical way to solve linear programming problems.
18. The transport task, its essence and formation.
19. Ways to find a basic solution.
20. The concept of integer linear programming problems.

###### **4.1.2 The discipline «Practical geomechanics»**

1. Basic concepts of mountain pressure.
2. The main properties of the array and its model.
3. The natural stress state of the rock mass.
4. Gravitational stresses in the array.
5. Types of natural stress state of the array.
6. Manifestations of rock pressure during excavation.
7. Stress state and displacement of the array around the workings.
8. Forms of destruction of workings.
9. The basic principles of ensuring the sustainability of workings.
10. Fastening of preparatory workings, types and parameters of fastening.

11. Foreign experience in assessing the stability of workings and choosing the type of support.
12. Mountain bumps. Basic concepts and definitions.
13. Conditions for the occurrence of high-impact situations.
14. Forecast of the impact hazard of sections of the rock mass.
15. Measures to reduce the impact hazard of workings.
16. Management of rock pressure in the development of shallow and inclined deposits.
17. The principle of mountain pressure control.
18. Principles of determining the load on the targets.
19. The stress state and strength of the tselikov.
20. Management of rock pressure during the re-development of shallow deposits.
21. Passport of rock strength.
22. Fracturing of rocks and their effect on strength.
23. What is the zone of inelastic deformation of rocks.
24. What is the isotropy and anisotropy of a rock mass?
25. Models describing the behavior of a rock mass.
26. Describe the elastoplastic model of the rock mass.
27. The coefficient of lateral pressure and how it affects the stress state of the rock mass.
28. The transition from the strength of the sample to the strength of the rock mass.
29. Maintenance of the developed space by ore columns.
30. Classification of ores and rocks by stability.

#### **4.1.3 Discipline «Modern problems in mining»**

1. The essence and current state of the combined technology.
2. Conditions of application and design of the combined technology.
3. Development of reserves of transition zones with combined technology.
4. Substantiation of the main parameters of the combined technology.
5. The main problems of effective application and development of combined technology.
6. Evaluation of the effectiveness and justification of the rational use of combined technology.
7. New promising technologies in the complex development of ore deposits.
8. Re-development of deposits.
9. Formation of the basic principles for the creation of low-waste technologies.
10. Research on the interaction of man-made spaces created with an array of rocks.
11. Development systems that ensure the completeness of the extraction of mineral reserves.



12. The influence of the main mining and geological and mining engineering conditions of development on the stability of man-made spaces.
13. The main provisions and the history of the development of geomechanics.
14. Priority and new scientific directions in geomechanics.
15. Objects and tasks of geomechanics research.
16. Modern problems in the field of rock destruction.
17. Development of scientific knowledge and practice in the field of rock destruction.
18. The object of research and tasks in the field of rock destruction.
19. Modern problems of underground mining.
20. Modern problems of open-pit mining.
21. Modern problems of maintaining mine workings.
22. Problems of mine ventilation and ensuring the safety of mining operations.
23. Personnel training for mining enterprises.
24. Geoinformation systems in mining.
25. Problems of numerical modeling of geomechanical processes.

**Essay topics for admission to doctoral studies in the educational program  
8D07202 «Mining »**

\$\$\$001

Waste-free mining technologies - myth or reality?

\$\$\$002

Modern problems of degassing coal seams

\$\$\$003

Restraining factors for the development of mining

\$\$\$004

In your opinion, how does the professional skills of a driller affect the quality of drilling and blasting operations in mine workings?

\$\$\$005

Explain the effect of the type of explosive and the design of the borehole on compliance with the design cross-section.

\$\$\$006

Prospects for the use of non-explosive destructive methods for driving workings

\$\$\$007

Highlight and justify the basic factors in the development of geotechnology

\$\$\$008

Describe the ways of rock hardening in the development workings

\$\$\$009

Feasibility of mining in difficult mining and geological conditions

\$\$\$010

Ways to ensure methane safety in coal mines