NJSC "ABYLKAS SAGINOV KARAGANDA TECHNICAL UNIVERSITY

Scientific and Methodological Council
Minutes No. 5
dated "18" 02 2026

PROGRAM
OF THE ENTRANCE EXAMINATION
for enrollment in doctoral studies
Educational program 8D07207 "Advanced metallurgical technologies"

Department "Metallurgy and new materials"
Compiled by:
Prof., Doctor of Technical Science
Makasheva A.M.
Senior lecturer, PhD Aubakirob D.R.
Associate Professor, Candidate of Technical Sciences Naboko E.P.

The program of the entrance exam for the educational program 8D07207 "Advanced metallurgical technologies" has been developed:
Prof., Doctor of Technical Science Makasheva A.M.
Senior lecturer, PhD Aubakirob D.R.
Associate Professor, Candidate of Technical Sciences Naboko E.P.

Discussed at the meeting of the Department of MNM
Protocol 12 from "18" 02 2026 y.

Head of the Department Aubakirov D.R.

The main topics to be submitted for the entrance exam

1 Theory of metallurgical processes

1.1 Basic metallurgical processes. Physico-chemical fundamentals of metallurgical processes. Thermodynamics and patterns of interaction of gases and complex gas atmospheres. Chemical strength of structures, compounds, defects of crystal structures. Mechanism and kinetics of oxidation of solid metals. The main theoretical provisions on the mechanism of reduction of metals and solid oxides. Interaction of sulfides with gases, metals and oxides. Carburization of iron with carbon monoxide. Structure and properties of metallurgical melts. Thermodynamics of slag systems. The interaction of dissolved iron-based elements. Thermodynamic patterns of carbon oxidation reaction in oxygen-containing iron. Kinetics of high-temperature heterogeneous metallurgical reactions. Kinetic patterns of decarbonization reaction. Enlargement and speed of phase separation.

1.2 Recommended literature

1. Voskoboinikov V.G., Kudrin V.A., Yakushev A.M. General metallurgy: a textbook for universities. Moscow: ICTS "Akademkniga", 2015. 768 p.

2. Tleugabulov, S. M. Physico-chemical fundamentals of metallurgy: a textbook for university students.

3. Vanyukov A.V., Zaitsev V.Ya. Theory of pyrometallurgical processes. Moscow: Metallurgiya, 1993.

4. B.N.Arzamasov, V.I.Makarova, G.G.Mukhin et al. Materials Science, Publishing House of Bauman Moscow State Technical University, 2001.

5. Shapovalov A.N. Theory of metallurgical processes: an educational and methodical manual Publishing House Novotroitskiy branch of the Federal State Educational Educational Institution of Higher Education "National Research Technological University "MISIS", 2020.

2 Metallurgical production technology

2.1 Fundamentals of recovery processes. Fundamentals of oxidative melting. Raw materials of metallurgical production. General characteristics of blast furnace melting processes. Formation of cast iron and slag. Steel production. Oxygen converter process. The current state and prospects of hearth processes of steel production. Production of steel in electric furnaces. Smelting of steels and alloys in open and vacuum induction furnaces. Production of ferroalloys. Classification of non-ferrous metals. Pyro-, hydro- and electrometallurgical methods for the production of non-ferrous metals.

2.2 Recommended literature

1. Bigeev V.A., Vdovin K.N., Kolokoltsev V.M., Salganik V.M., Sibagatullin S.K., Sychkov A.B., Chernov V.P., Cherchintsev V.D., Chukin M.V. Fundamentals of metallurgical production: textbook Lan Publishing House, 2020.

2. Krivandin V.A. Heat engineering of metallurgical production. Textbook for universities. Moscow: MISIS, 2002.

3. Voskoboinikov V. G., Kudrin V. A., Yakushev A.M. General metallurgy. - 6th ed., revised and additional materials. Moscow: ICTS Akademkniga, 2005.

4. Goldstein M.N., Grachev S.V., Veksler Yu.G. Special steels. Moscow: MISIS, 1999.

5. Simonyan L.M., Semin A.E., Kochetov A.I. Metallurgy of special steels. Theory and technology of special electrometallurgy. Moscow: MISiS, 2007.

6. B.N.Arzamasov, V.I.Makarova, G.G.Mukhin et al. Materials Science, Publishing House of Bauman Moscow State Technical University, 2001.

7. A.P.Gulyaev. Metal science. Publishing house "Metallurgy", 1977.

3 Modern technologies and equipment in metallurgy

3.1 Technological processes in metallurgy; introduction of new methods in production, innovative development in metallurgy. Advantages and disadvantages of modern technologies for the production of metals and alloys; methods of quality control in the production process; technologies for obtaining promising metals and alloys, nanotechnology.

3.2 Recommended literature

1. Digonskiy S.V. Theoretical foundations and technology of reducing melting of metals from non-processed raw materials. Moscow: Nauka, 2017. 235 p.

2. Semenov B.I., Kushtarov K.M. Production of metal products in a solid-liquid state. New Industrial Technologies. Moscow: Bauman Moscow State Technical University, 2020. 310 p.

3. Nikiforov V. M. Technology of metals and other structural materials. Moscow: Politechnika, 2016. 185 p.

4. Makasheva A.M. Modern technologies and equipment in metallurgy: A textbook. Karaganda: Publishing house of Maps, 2021. 98 p

5. Bigeev A.M., Metallurgy of steel, textbook for universities.— 2nd ed., revised and add.— M.: Metallurgy, 2008. 480 p.

6. Roshchin V.E. Electrometallurgy and metallurgy of steel: textbook - Chelyabinsk: SUSU Research Center, 2013. 572 p.

7. Gasik M.I., Lyakishev M.I. Physico-chemistry and technology of electroferro-alloys. Dnepropetrovsk: System Technologies, 2005. 448 p.

8. Ryss M.A. Production of ferroalloys – M. Metallurgy, 1985. – 244 p.

9. Bratkovsky E.V., Zavodyany A.V. Electrometallurgy of steel and special electrometallurgy. Educational and methodical manual for students of specialty 150101 "Metallurgy of ferrous metals" of all forms of education. Novotroitsk: SF MISiS, 2008. 115 p.

10. Innovative technologies in metallurgy: Textbook / V.Y. Kulikov; A.Z. Isagulov, E.P. Shcherbakova Karaganda State Technical University. Karaganda: Publishing house of KSTU, 2015. 71 p.