NAO "KARAGANDA TECHNICAL UNIVERSITY
NAMED AFTER ABYLKAS SAGINOV"

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PROGRAM
ENTRANCE EXAM
for applicants to doctoral studies
educational program 8D07101 "Mechanical Engineering", 8D07106 "Technological Machines and Equipment (by Industry)"

Department of technological equipment,
mechanical engineering and standardization
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The program of the entrance examination for the educational program 8D07101 "Mechanical Engineering", 8D07106 "Technological Machines and Equipment (by Industry)" was developed by:

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Discussed at the meeting of the TEMandS department

Protocol No. 13 dated "19" 02 2026

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Introduction

The entrance examination for doctoral studies consists of writing an essay, passing a test of readiness for doctoral studies, an exam on the profile of the educational program and an interview.

Persons holding a certificate (TOEFL ITP (Test of English as a Foreign Language Institutional Testing Program) take additional testing of English proficiency before the entrance exam to doctoral studies. The number of test questions of additional testing of English proficiency is 100 questions. The maximum number of points is 100 points. Additional testing of English proficiency is assessed in the form of "pass" or "failure to pass". To receive the grade "pass", it is necessary to score at least 75 points.

Assessment of the entrance examination for doctoral studies:

- interview - 20 points;
- essay - 10 points;
- passing the test for readiness for doctoral studies - 30 points;
- exam on the profile of a group of educational programs - 40 points.

The passing score for admission to doctoral studies under the state educational order is 75 points, the passing score for admission to doctoral studies on a fee-paying basis is 75 points.

The duration of the entrance exam is 4 hours, during which the applicant writes an essay, takes a test on readiness for doctoral studies, and answers an electronic examination ticket consisting of 3 questions.

The exam on the profile of the educational program includes 3 questions, of which: the 1st question determines the level and systematicity of theoretical knowledge; the 2nd question reveals the degree of formation of functional competencies; the 3rd question is aimed at determining systemic competencies.

When preparing for the exam, it is recommended to use the literature provided in the list, as well as modern periodical scientific and technical literature.

1Progressive technologies in mechanical engineering

1.1 Innovative methods and materials used for mechanical engineering enterprises.

Application of innovative methods and materials for manufacturing machine parts using modern progressive processing methods. Methods of processing parts from high-strength materials with high productivity, during the processing of which either there is no cutting tool or the tool has less strength than the material being processed. Application of additive technologies and artificial intelligence in the processing of materials in the mechanical engineering industry.

Recommended reading

1. Bely A.V. et al. Surface hardening treatment using concentrated energy flows. - Minsk: Science and Technology, 2016. - 79 p.

2. Plasma surface hardening. - Kyiv: Tekhnika, 2017. – 108 p.

3. Papshev D.D. Finishing and hardening treatment by surface plastic deformation. - M.: Mechanical Engineering, 2015 – 152 p.

4. A.A.Khvorostukhin, S.V.Shishkin, A.P.Kovalev Increasing the bearing capacity of machine parts by surface plastic deformation. - M.: Mechanical Engineering 2017.- 211 p.

1.2 Automation and digitalization of mechanical engineering enterprises

Automation involves the implementation of automated control systems and equipment, which allows for increased efficiency of production processes, reduced costs and improved product quality.

Digitalization, in turn, includes the introduction of digital technologies into all aspects of the enterprise's activities, from design and production to management and logistics. This allows for the creation of a single information space, prompt access to data, and informed decision-making based on the analysis of large volumes of information.

Recommended reading

1. Shaduya, V.L. Modern methods of materials processing in mechanical engineering: textbook / V.L. Shaduya. - Minsk: Tekhnoperspektiva, 2008. - 314 p.

2. Smolentsov, V.P. Electrophysical and electrochemical methods of materials processing: in 2 volumes / edited by V.P. Smolentsov. – M.:

Higher. school, 1983. – V.1. – Processing of materials using tools. – 247 p.

3. Smolentsov, V.P. Electrophysical and electrochemical methods of materials processing: in 2 volumes / edited by V.P. Smolentsov. - M.: Higher School, 1983. - V.2. - Materials processing using highly concentrated energy sources. - 208 p.

4. Foteev, N.K. Technology of electrical discharge machining of materials / N.K. Foteev. - L.: Mechanical Engineering, 1984. - 184 p.

5. Babichev, A.P. Vibration processing of parts: 2nd edition, revised and enlarged. – M.: Mashinostroenie, 1974. – 133 p.

1.3 Production processes and management of mechanical engineering enterprises

Manufacturing processes in mechanical engineering include a wide range of

operations related to the manufacture of parts and assembly of machines and mechanisms.

These processes begin with the production of blanks and include various methods of material processing, such as cutting, pressure, heat treatment and others.

The management of production processes in mechanical engineering enterprises requires effective organization, planning and control. This includes resource management, optimization of technological processes, ensuring product quality and meeting order deadlines.

Recommended reading

1. Zholobov, A.A. Technology of automated production: textbook for universities / A.A. Zholobov. - Minsk: Design PRO, 2000. - 623 p.

2. Electrohydropulse processing of materials in mechanical engineering / V.N. Chachin, K.N. Bogoyavlensky. - Minsk: Science and Technology, 1987. - 231 p.

3. Kovshov, A.N. Mechanical engineering technology: textbook / A.N. Kovshov. - M.: Mechanical engineering. 1987. - 320 p.

4. Mostalygin G.P., Tolmachevsky N.N. Technology of mechanical engineering. Moscow: Mechanical Engineering, 1990. – 288 p.

5. Kolesov, I.M. Fundamentals of mechanical engineering technology: textbook. For mechanical engineering specialty universities / I.M. Kolesov. - 2nd ed., corrected. - M.: Higher. school, 2001. - 591 p.

6. Ed. by V. P. Smolentsev Electrophysical and electrochemical methods of materials processing: a textbook for mechanical engineering universities /. in two volumes. - M.: Higher School, 2017. - 255 p.

7. Ed. by L. Ya. Popilov Electrophysical and electrochemical processing of materials. Handbook. L. - M.: Mechanical Engineering, 2015. - 501 p.

8. Babichev P.P. Vibration processing of parts. - M.: Mechanical Engineering, 2013. - 390 p.

1.4 Safety and sustainability of engineering enterprises

Safety and sustainability in mechanical engineering enterprises is a multifaceted topic covering various aspects of the enterprise's activities.

Safety in this context refers to the creation and maintenance of working conditions that minimise risks to the health and safety of workers. This includes:

- Occupational safety
- Industrial safety
– Occupational Health and Safety Risk Management

Sustainability refers to the ability of an enterprise to adapt to changing conditions, minimize negative impacts on the environment and ensure long-term operation.

Both aspects, safety and sustainability, play an important role in ensuring efficient and responsible operations of mechanical engineering companies.

Recommended reading

1. Volosatov V. A. Ultrasonic treatment. - Lenizdat, 2015. - 335 p.

2. Stepanov B. I. Lasers today. - Minsk: Higher School, 2022. - 167 p.

3. Golovachev V. A et al. Electrophysical dimensional processing of complex-shaped parts. - M.: Mechanical Engineering, 2016. - 401 p.

4. Grilikhes S. Ya. Electrochemical polishing. - L.: Mechanical Engineering, 2016. - 289 p.

5. Matalin A. A. Technological methods for increasing the durability of machine parts. - Kyiv: Tekhnika, 2018. - 234 p.

6. Poduraev V. N. Cutting of hard-to-machine materials. - M.: Mechanical Engineering, 2016. - 578 p.

7. Polevoy S.N., Evdokimov V.D. Hardening of metals. Handbook. – M.: Mechanical Engineering, 2016. – 320 p.

8. Polyak M.S. Hardening technology. In 2 T. T.1. - M.: "L.V.M-SCRIPT", "Machine Building", 2015. – 832 p.

9. Hardening of parts surfaces by a combined method. - M.: Mechanical Engineering, 2015. – 144 p.

2Computer technologies in mechanical engineering

2.1 Application of computer technologies in mechanical engineering enterprises

Computer technologies have become an integral part of the activities of modern engineering enterprises. They penetrate into all stages of the product life cycle, from design to production and operation. The use of computer technologies in engineering enterprises is aimed at increasing production efficiency, improving product quality, reducing the time of development and launching new products on the market, as well as ensuring the competitiveness of enterprises in the conditions of the modern economy.

Recommended reading

1. Cherepashkov A.A., Nosov N.V. Computer technologies, modeling and automated systems in mechanical engineering. - Volgograd: In-Folio, 2009. - 592 p.

2. Alyamovsky A.A. SolidWorks. Computer modeling in engineering practice. - SPb: BHV-Petersburg, 2012. - 1040 p.

3. Kovshov A.N. Information support for the life cycle of mechanical engineering products: principles, systems and technologies CALS/IPI. - M.: Academy, 2017. - 304 p. 4. Dudareva N.Yu., Zagayko S.A. SolidWorks 2014 on examples. - St. Petersburg: BHV-Petersburg, 2014. - 544 p.

5. Beisembaev K.M. Practical and research aspects of development of mining machines in 3D: a textbook for universities. - Karaganda: KarSTU, 2012. - 135 p.

2.2 Application of CALS technologies in mechanical engineering

In mechanical engineering, CALS technologies play an important role, ensuring effective information management at all stages of the product life cycle.

CALS (Continuous Acquisition and Lifecycle Support) is a strategy aimed at increasing the efficiency of information exchange between all participants in the process of product creation and support.

In mechanical engineering, this is especially relevant, since the production of complex equipment requires the coordination of efforts of many departments and suppliers.

Recommended reading

1. Bolshakov V.P., Bochkov A.L., Lyachek Yu.T., Solid modeling of parts in CAD systems: AutoCAD, KOMPAS-3D, SolidWorks, Inventor, Creo. —SPb: Piter, 2015. – 480 p.

2. Goncharov P.S., Eltsov M.Yu., Korshikov S.B., Laptev I.V., Osiyuk V.A. NX for the machine-building designer. - Moscow: ID DMK Press, 2009. - 376 p.

3. Goncharov P.S., Eltsov M.Yu., Korshikov S.B., Laptev I.V., Osiyuk V.A. NX for the machine-building designer. - Moscow: ID DMK Press, 2010. - 504 p.

4. Scientific and practical conference "Additive technologies in Russian industry". Moscow, 2015.

5. Khrustalev, D. On the specifics of using imported components in military and special equipment / D. Khrustalev // Components and technologies. – 2001. – No. 7. – P. 4–5.

6. Yakubaitis, E.A. Information networks and systems / E.A. Yakubaitis. - M.: Finance and Statistics, 1996. - 234 p.

7. Lee, K. Fundamentals of CAD/CAM/CAE / K. Lee. – St. Petersburg: Piter, 2004. – 560 p.

8. SolidWorks::http://www.solidworks.com/sw/products/details.htm?productid=514

9. ASCON – comprehensive solutions for automation of engineering activities and production management. CAD/AEC/PLM. http:// ascon.ru/

10. Top Systems – developer of the PLM software package T-FLEX CAD/CAM/CAE/CAPP/PDM.http://www.tflex.ru/

11. Nei Nastran in Russia and the CIS – Finite element analysis system CAD/FEA/CAE.http://www.nenastran.ru/

12. Welcome to ANSYS, Inc. – Corporate Homepage.http://www. ansys.com

13. ANSYS, Inc. Products.http://www.ansys.com/products/default.asp

14. LS-DYNA.RU – calculation results, training courses, newshttp://www.ls-dyna.ru

15. TechnologiCS 6|TechnologiCS.http://www.technologics.ru

16. Consistent Software.http://www.consistent.ru/soft

3 Automated design systems for machines and processes

3.1 Basic principles of operation of computer-aided design systems in mechanical engineering

Computer-aided design (CAD) systems have become an integral part of modern mechanical engineering. They are a complex of software and hardware tools designed to automate the processes of design, construction and analysis of engineering objects.

Recommended reading

1. Malyukh V.N. Introduction to modern CAD: lecture course. – Moscow: DMK Press, 2010. – 190 p.

2. Kudryavtsev E.M. Computer-aided design systems for machines and equipment. – Moscow: ASV, 2013. – 383 p.

3. Muromtsev D.Yu. Mathematical support for CAD. / D.Yu. Muromtsev, I.V. Tyurin. – Moscow: Lan, 2014. – 464 p.

4. Ryabov Yu.V., Computer technologies in automated design of mechanical

engineering products: a tutorial / Ufa State Aviation Technical University. - Ufa: Ufa State Aviation Technical University, 2008. - 128 p.

5. Berliner E.M., Taratynov O.V. CAD in mechanical engineering. – M.: FORUM, 2008. – 448 p.

3.2 Application of CAD for design and analysis in mechanical engineering enterprises

The use of computer-aided design (CAD) systems in mechanical engineering enterprises is radically changing the design and analysis processes, bringing significant benefits.

CAD allows you to create three-dimensional models of parts and assemblies, which provides a visual representation of the object. This, in turn, facilitates the design process and allows you to identify potential problems at an early stage.

Recommended reading

1. Ushakov D.M. Introduction to the Mathematical Foundations of CAD [Electronic resource]: lecture course. – Moscow: DMK PRESS, 2011. – 208 p.

2. Vasilyeva T.Yu. Computer graphics. 3D modeling using the AutoCAD computer-aided design system: laboratory practical training / T.Yu. Vasilyeva, L.O. Mokretsova, O.N. Chicheneva; National University of Science and Technology (MISiS). – Moscow: MISiS, 2013. – 48 p.

3. Malyukh V. N. Introduction to modern CAD: Lecture course. - M.: DMK Press, 2010. - 192 p.

4. Ushakov D.M. Introduction to the mathematical foundations of CAD: a course of lectures. - M.: DMK Press, 2011. - 208 p.

5. Lee, K. Fundamentals of CAD/CAM/CAE / K. Lee. – St. Petersburg: Piter, 2004. – 560 p.

Essay Topics

1. Digital technologies in mechanical engineering.
2. Application of additive technologies in mechanical engineering.
3. Automated design system for production processes.
4. Problems of using robotic systems.
5. Problems of implementing flexible manufacturing systems.
6. Problems of implementation of information technologies in mechanical engineering production.
7. Development of control programs for machines with various CNC.
8. Design of technological processes for various types of modern production.
9. The role of mechanical engineering in the development of the economy of the Republic of Kazakhstan.
10. Features of technological solutions in the layout of CNC equipment.