NON-PROFIT JOINT STOCK COMPANY
«ABYLKAS SAGINOV KARAGANDA TECHNICAL UNIVERSITY»

THE PROGRAM
OF THE ENTRANCE EXAMINATION FOR APPLICANTS TO SPECIALIZED DOCTORAL STUDIES

in educational program 8D07105 “Innovative mechanical engineering”
group of educational programs D103 – Mechanics and metalworking

Department TOMiS
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Introduction

Educational program for the preparation of Doctor of Philosophy (PhD) specialty **8D07105 – "Innovative mechanical engineering"** involves fundamental educational, methodological and research training based on obtaining deep specialized knowledge and competencies in the chosen field.

The previous minimum level of education for persons wishing to master doctoral educational programs is a master's degree. In this regard, doctoral entrance examination programs are formed by higher educational institutions and scientific organizations on the basis of professional master's programs.

In accordance with the Standard Admission Rules, the entrance exam to doctoral studies is formed from the disciplines of the state component of the master's program of the specialty of the same name.

Entrance exam for specialty **8D07105 – "Innovative mechanical engineering"** is carried out in written form in the following disciplines:

– organization and planning of scientific research and innovation activities;

– control systems in mechanical engineering;

– qualimetry in mechanical engineering.

The examination task contains three questions, one from each of the above disciplines.

Questions on the discipline "Qualimetry in Mechanical Engineering" contain the solution to a practical task.

Questions in the discipline "Control systems in mechanical engineering" contain the implementation of a practical task on a PC (personal computer).

The exam is graded according to the table.

Letter grade	Percentage of knowledge acquired	Traditional assessment
A A-	95-100 90-94	Great
B+ IN IN-	85-89 80-84 75-79	Fine
C+ WITH WITH- D+ D-	70-74 65-69 60-64 55-59 50-54	Satisfactorily
F	0-49	Unsatisfactory

The time allotted for the entrance exam to doctoral studies is 3 hours (180 minutes) without a break.

1 Progressive technologies in mechanical engineering

1. List the innovations used in the field of materials for mechanical engineering today.
2. Determine how additive manufacturing technologies affect parts manufacturing processes?
3. Identify the advantages and disadvantages that computer technologies have in mechanical engineering.
4. List the materials processing technologies that are most promising for use in mechanical engineering.
5. List new materials that have found application in mechanical engineering in recent years.
6. Determine how digitalization affects the design and production processes in mechanical engineering.
7. List what new methods of heat treatment of materials are used in mechanical engineering.
8. List what nanoprocessing technologies are used in modern mechanical engineering.
9. List what methods and technologies in the field of artificial intelligence are used in mechanical engineering.
10. Determine what new quality control technologies are used in mechanical engineering to ensure high accuracy and reliability of products.
11. Determine how advanced technologies in mechanical engineering affect the competitiveness of enterprises in the global market.
12. List modern high-performance methods for obtaining blanks.
13. List innovative cutting technologies.
14. Define high speed cutting.
15. List the combined methods of machining.
16. Define innovative technologies for physical and technical processing of materials.
17. Fundamentals of additive technologies for shaping parts and assemblies.
18. List the methods for producing high-temperature coatings.
19. List the methods for producing nanocoatings .
20. List the methods for producing polymer coatings.

Recommended reading

1. Shaduya V.L. Modern methods of materials processing in mechanical engineering: textbook. allowance / V.L. Shaduya. – Minsk: Technoperspective, 2008. – 314 p.
2. Smolentsov V.P. Electrophysical and electrochemical methods of processing materials: in 2 volumes / edited by V.P. Smolentsova. – M.: Higher school, 1983. – T.1. – Processing of materials using tools. – 247 p.
3. Smolentsov V.P. Electrophysical and electrochemical methods of processing materials: in 2 volumes / edited by V.P. Smolentsova. – M.: Higher school, 1983. – T.2. – Processing of materials using highly concentrated energy sources. – 208 p.
4. Foteev N.K. Technology of electrical discharge processing of materials / N.K.

Foteev. – L.: Mechanical Engineering, 1984. – 184 p.

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

6. Zholobov A.A. Automated production technology: a textbook for universities / A.A. Zholobov . – Minsk: Design PRO, 2000. – 623 p.

7. Electrohydropulse processing of materials in mechanical engineering / V.N. Chachin K.N. Epiphany. – Minsk: Science and Technology, 1987. –231 p.

8. Kovshov A.N. Mechanical engineering technology: textbook / A.N. Kovshov. – M.: Mechanical Engineering, 1987. – 320 p.

9. Mostalygin G.P., Tolmachevsky N.N. Mechanical engineering technology. M.: Mechanical Engineering, 1990. – 288 p.

10. Kolesov I.M. Fundamentals of mechanical engineering technology: textbook. For mechanical engineering specialist universities / I.M. Kolesov. – 2nd ed., rev. – M.: Higher school, 2001. – 591 p.

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

12. Ed. L. Ya. Popilova. Electrophysical and electrochemical processing of materials. Directory. L. – M.: Mechanical Engineering, 2015. – 501 p.

13. Babichev P.P. Vibration processing of parts. – M.: Mechanical Engineering, 2013. – 390 p.

14. Volosatov V.A. Ultrasonic treatment. – Lenizdat, 2015. – 335 p.

15. Stepanov B.I. Lasers today. – Minsk: Higher School, 2022. – 167 p.

16. Golovachev V.A. et al. Electrophysical dimensional processing of parts of complex shape. – M.: Mechanical Engineering, 2016. – 401 p.

17. Grilikhes S.Ya. Electrochemical polishing. – L.: Mechanical Engineering, 2016. – 289 p.

18. Matalin A.A. Technological methods for increasing the durability of machine parts. – Kiev: Tekhnika, 2018. – 234 p.

19. Poduraev V. N. Cutting difficult-to-cut materials. – M.: Mechanical Engineering, 2016. – 578 p.

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

21. Polyak M.S. Hardening technology. In 2 T. T.1. – M.: “L.V.M-SCRIPT”, “Mechanical Engineering”, 2015. – 832 p.

22. Hardening the surfaces of parts using a combined method. – M.: Mechanical Engineering, 2015. – 144 p.

23 . Bely A.V. and others. Surface hardening treatment using concentrated energy flows. – Minsk: Science and technology, 2016. – 79 p.

24. Plasma surface hardening. – Kiev: Tekhnika, 2017. – 108 p.

25. Papshev D.D. Finishing and strengthening treatment by surface plastic deformation. – M.: Mechanical Engineering, 2015. – 152 p.

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

2 Computer technologies in mechanical engineering

1. List the advantages of using computer technology in mechanical engineering compared to traditional design methods.
2. Evaluate how computer technology affects the reduction of machine design time.
3. List the modeling methods used to analyze stresses and deformations in machine parts using computer technology.
4. Determine the role of computer technology in optimizing machine design.
5. List the virtual testing methods used in machine design.
6. Identify how computer technology helps in improving production processes in mechanical engineering.
7. List the software products used to create three-dimensional models of cars.
8. Evaluate the role of computer modeling in the design of machines and machine control systems.
9. Determine how computer technology can reduce the cost of creating and testing machine prototypes.
10. Determine how computer technology is used in the analysis of vibration and noise in mechanical engineering.
11. List the methods of computer modeling used to analyze the dynamics of machines.
12. Identify how computer technology assists in simulating machine assembly and maintenance processes.
13. Identify how computer technology influences the ability of designers and engineers to create innovative solutions in mechanical engineering.
14. List the prospects associated with the development of computer technology in mechanical engineering in the near future.
15. Application of CALS technologies in mechanical engineering.
16. Computer support and product life cycle support.
17. PLM systems in mechanical engineering.
18. Prototyping technologies
19. Application of CAD/CAM/CAE technologies in mechanical engineering.
20. List the software tools used in the design of machines using computer technology.

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. – St. Petersburg: BHV-Petersburg, 2012. – 1040 p.
3. Kovshov A.N. Information support for the life cycle of mechanical engineering products: principles, systems and technologies of CALS/IPI. – M.: Academy, 2017. – 304 p.
4. Dudareva N.Yu., Zagaiko S.A. SolidWorks 2014 with examples. – St. Petersburg: BHV-Petersburg, 2014. – 544 p.
5. Beisembaev K.M. Practical and research aspects of the development of mining

machines in 3D: a textbook for universities. – Karaganda: KSTU, 2012. – 135 p.

6. Bolshakov V.P., Bochkov A.L., Lyachek Yu.T., Solid modeling of parts in CAD systems: AutoCAD, KOMPAS-3D, SolidWorks, Inventor, Creo. – St. Petersburg: Peter, 2015. – 480 p.

7. Goncharov P.S., Eltsov M.Yu., Korshikov S.B., Laptev I.V., Osiuk V.A. NX for mechanical engineering designers. – Moscow: DMK Press, 2009. – 376 p.

8. Goncharov P.S., Eltsov M.Yu., Korshikov S.B., Laptev I.V., Osiuk V.A. NX for mechanical engineering designers. – Moscow: DMK Press Publishing House, 2010. – 504 p.

9. Scientific and practical conference “Additive technologies in Russian industry”. – Moscow, 2015.

10. Khrustalev D. On the features of the use of imported components in military and special equipment / D. Khrustalev // Components and technologies. – 2001. – No. 7. – P. 4–5.

11. Yakubaitis , E.A. Information networks and systems / E.A. Jakubaitis . – M.: Finance and Statistics, 1996. – 234 p.

12 Lee, K. Fundamentals of CAD (CAD/CAM/CAE) / K. Lee. – St. Petersburg: Peter, 2004. – 560 p.

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

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

15. T-FLEX PLM software package CAD / CAM / CAE / CAPP / PDM. – http :// www . tflex . ru /

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

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

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

19. LS-DYNA.RU – calculation results, training courses, news. – http://www.ls-dyna.ru

20. TechnologiCS 6|TechnologiCS. – http://www.technologics.ru

21. Consistent Software. – http://www.consistent.ru/soft

3 Computer-aided design systems for machines and processes

1. List the basic principles of operation of computer-aided design systems in mechanical engineering.

2. List the types of computer-aided design systems that exist in mechanical engineering.

3. List the software products related to computer-aided design systems in mechanical engineering.

4. Assess the role of CAD (Computer-Aided Design) in computer-aided design systems.

5. Determine how computer-aided design systems contribute to the optimization of production in mechanical engineering.

6. List the main functions performed by computer-aided design systems in mechanical engineering.

7. Evaluate the advantages of computer-aided design over traditional design methods.

8. List the main design stages when using computer-aided design systems in mechanical engineering.

9. Define the role of the CAM (Computer-Aided Manufacturing) in computer-aided design systems in mechanical engineering.

10. Evaluate the development trends that can be identified in the field of computer-aided design systems in mechanical engineering.

11. Determine how computer-aided design systems influence the processes of maintenance and repair of machinery and equipment.

12. Identify problems that may arise when implementing computer-aided design systems in mechanical engineering and how they can be overcome.

13. Evaluate how computer-aided design systems affect the timing and quality of design in mechanical engineering.

14. Identify prospects for the development of computer-aided design systems in mechanical engineering can be expected in the near future.

15. Define CAD/CAE systems. A set of software tools included in CAD/CAE systems.

16. Describe block -hierarchical and structural approaches to the design of technical objects.

17. Analyze the functionality of CAD/CAE systems.

18. Define software, information, linguistic and methodological support of CAD.

19. History of the development of systems in the automation of design and production preparation.

20. Surface modeling. List the advantages and disadvantages of surface modeling.

Recommended reading

1. Malyukh V.N. Introduction to modern CAD: a course of lectures. – 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. CAD software. / D.Yu. Muromtsev, I.V. Tyurin. – Moscow: Lan, 2014. – 464 p.

4. Ryabov Yu.V., Computer technologies in automated design of mechanical engineering products: textbook / Ufimsk . state aviation tech . univ. – Ufa: UGATU, 2008. – 128 p.

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

6. Ushakov D.M. Introduction to the mathematical foundations of CAD [Electronic resource]: course of lectures. – Moscow: DMK PRESS, 2011. – 208 p.

7. Vasilyeva T.Yu. Computer graphics. 3D modeling using the AutoCAD computer-aided design system: laboratory workshop / T.Yu. Vasilyeva, L.O.

Mokretsova, O.N. Chicheneva; National Research Technological University (MISIS). – Moscow: MISIS, 2013. – 48 p.

8. Malyukh V.N. Introduction to modern CAD: A course of lectures. – M.: DMK Press, 2010. – 192 p.

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

10. Lee K. Fundamentals of CAD (CAD/CAM/CAE) / K. Lee. – St. Petersburg: Peter, 2004. – 560 p.