

ABSTRACT

**Study plan: 22.04.01 « Materials Science and materials technology »
Materials Science Division of Engineering School of Advanced Manufacturing
Technologies**

Master degree Programs:

Technological design

Olga Y. Vaulina
Phone: +7 (3822) 606-153
E-mail: kolgay@tpu.ru

Advanced materials in the oil and gas business

Zhanna G. Kovalevskaya
Phone: +7 (3822) 706-351
E-mail: kovalevskaya@tpu.ru

Production of products from nanostructured materials and additive technologies

Galina V. Lyamina
Phone: +7 (3822) 706-347
E-mail: lyamina@tpu.ru

Materials Science and design

Maria S. Petyukevich
Phone: +7 (3822) 606-165
E-mail: petukevich@tpu.ru

The entrance test (ET) program in 22.04.01 "Materials Science and materials technology" was developed on the basis of Federal State Standards for Higher Education (level "Bachelor") and is interdisciplinary in nature.

The purpose of the entrance examinations is to select the entrants who are most capable and prepared to study the chosen educational program, as well as to ensure inter-university and inter-program mobility of undergraduate graduates entering the main professional educational programs of higher education at the master's level.

GENERAL REQUIREMENTS FOR ENTRANTS

The exam for entrants of the Master's program in 22.04.01 "Materials Science and materials technology" (master degree program implemented in English) is conducted in the form of an oral interview and has two parts.

1. Summary - a brief introduction of the applicant.

Summary plan:

1) education: direction (profile)/specialty; university; self-assessment of the level of competencies achieved within the framework of the field of study, skills in conducting of scientific research, experience in working with research equipment, etc.;

2) brief annotation of research or project work carried out earlier: presentations at conferences; participation in competitions or projects; publication of the results of work in various databases (RSCI, Scopus, WoS, etc.); brief information about internships, additional courses. learning;

3) description of the areas of scientific interests (their versatility) and the desired trajectory of personal development and career growth.

The duration of the performance is 3-5 minutes.

2. Oral interview on the topic

An oral conversation is carried out by the examination committee with each applicant (entrant) individually. The applicant is asked questions that allow assessing the level of development of basic engineering (general professional) competencies.

Each entrant has no more than 30 minutes.

An entrance test in the form of an oral interview is conducted by the examination committee and can be organized at special sites (in the classroom) or remotely. If necessary, the procedure for conducting an entrance test remotely is controlled by an observer.

On the day of the entrance examination, applicants are allowed into the auditorium where the entrance examination is conducted, according to the list, in which each applicant is assigned the time of the interview.

The criteria for evaluating the interview are communicated to applicants at least 3 months before the start of the entrance test.

The interview with each applicant includes **3 questions** – one randomly selected question from the sections of the entrance test program – "Contents of the sections and topics of the entrance test program." To prepare for the ET, an applicant can use the section "Recommendations for preparing for the entrance test."

The procedure for passing the entrance test in a remote form is regulated by the documents in the current edition approved by the orders of the rector: the Regulations on the conduct of entrance tests to the TPU magistracy and the Procedure for the conduct of entrance tests.

The examination committee may ask 1-2 additional questions on the topics of sections of the test program. The applicant's answers to the questions of the oral interview are recorded in the exam report which is drawn up immediately after and is brought to the attention of the applicant under the signature of the applicant.

An applicant who does not agree with the exam assessment and (or) in connection with the violation of the exam procedure has the right to appeal. The procedure for filing and considering an appeal is regulated by the Regulation on the Appeal Commission TPU.

The competition for admission within the training direction 22.04.01 "Materials Science and materials technology" is conducted by educational programs, but the result of the entrance test, passed on one program, can be accepted for credit on other programs. To participate in the competition for admission to the program Materials Science and design / Materials science and design of new materials (implementation of the program in English), the applicant must confirm the level of English language through an additional interview in English.

EVALUATION CRITERIA

The result of the entrance test is determined as the sum of points for the summary and oral interview, including answers to additional questions.

The maximum total score of the entrance exam is 100.

The minimum score confirming the successful completion of the entrance test is 56*.

The total score is determined as the sum of points for the answers to each of the questions including additional ones.

The answer to each of the questions is evaluated by the examination committee separately taking into account the following criteria:

1. The score for the resume is set on a 10-point scale in accordance with the following criteria:

Score	Criteria
0-5	the applicant did not provide information on all points of the summary plan stated in the requirements for the entrance examination procedure (given an incomplete answer)
6-10	the applicant gave a detailed answer, the summary is presented according to the plan stated in the requirements for entrance examinations

2. The score for an oral conversation on the topic of is set on a 90-point scale in accordance with the following criteria:

Score	Criteria
0-8	An empty answer, ignorance of the basic concepts, inability to apply knowledge in practice.
9-15	Partially correct or insufficiently complete answer or solution of the problem indicating significant gaps in the theoretical and practical preparation of the subject; formal answers, misunderstanding of the essence of the question.
17-25	Sufficiently complete understanding of the subject, good knowledge, skills and practical experience; the necessary learning outcomes are formed. Fairly complete answer is presented; there are minor flaws in the presented solution of the practical problem.
25-30	Informal and informed, deep and complete answer (theoretical and practical). There was demonstrated an excellent understanding of the subject, comprehensive knowledge, ability to substantiate the answer and prove the judgments by practical solution of the problem.

** If the applicant receives less than 56 points for the interview, he is not allowed to participate in the competition, as he did not pass the entrance test.*

CONTENTS OF SECTIONS AND TOPICS OF THE ENTRANCE TEST PROGRAM

Section 1. Materials science

1. Crystal lattices. Anisotropy. Polymorphism.
2. State diagrams of binary alloys. Liquidus. Solidus. Phases, solid solution, solid solution, mechanical mixture, chemical compound.
3. Crystallisation. Structure of ingot. Dendritic liquation. Defects in crystal structure.
4. Fracture. Fracture mechanisms and fracture structures.
5. Polymorphic, eutectic, peritectic and eutectoid transformations in Fe-C alloys.
6. Carbon steels. Classification by purpose, degree of deoxidation, quality, carbon content and position on the Fe-C diagram.
7. Cast irons. Classification by the form of graphite inclusions and phase composition of the metal matrix. Graphitisation. Advantages and disadvantages of cast irons as structural materials.
8. Types of heat treatment, peculiarities of the main types.
9. Features of heat treatment for pre- and zavitoid steels.
10. Alloyed steels. Classification of alloy steels by composition, structure and purpose.
11. Copper and its alloys.
12. Aluminium and its alloys. Foundry alloys. Deformable alloys.
13. Titanium, magnesium, zirconium and alloys based on them.
14. Polymers. Thermoplastics. Reactoplastics
15. Technical ceramics. Peculiarity of structure and properties.
16. Composite materials. Principles of formation.
17. Russian system of steel labelling
18. Phases and structure in metal alloys
19. Quality of mechanical engineering products. Durability. Role of surface.
20. Types of composite materials.

Section 2. Production of products from nanostructured materials and additive technologies

1. Types of chemical bonds in solids
2. Inorganic glass. glassy state
3. Silicon oxide: properties and products based on it
4. Aluminum oxide: properties and products based on it
5. Nanomaterials. Basic concepts.

Section 3. Properties of materials

1. Stress. Strain. Plastic deformation mechanisms
2. Dislocations. Burgers vector. Interaction of dislocations
3. Mechanical tests for tension, compression, bending,
4. Mechanical properties of the materials.
5. Dynamic testing
6. Fatigue of metals
7. Creep
8. Brinell hardness. Rockwell hardness. Vickers hardness, microhardness
9. Methods of strength improvement

10. Thermal capacity, thermal conductivity, thermal expansion of solid bodies
11. Types of porosity. Permeable and impermeable porous materials
12. The shape and state of the surface of the pores
13. Properties of porous materials based on metal compounds
14. Sorption processes. Adsorption and Absorption
15. Adhesion and cohesion

Section 4. Materials technology

1. Physical basis for the production of castings. High-performance casting methods.
Casting in disposable and reusable molds
2. Physical foundations of metal forming. rolling production
3. Volumetric and sheet stamping
4. Cutting. Non-contact cutting methods. Blade and abrasive cutting.
5. Physical basis for obtaining a welded joint
6. Welding methods: mechanical, thermal, thermomechanical.
7. Soldering of metals. Soldering methods
8. Technologies and equipment for the production of materials for powder metallurgy
9. Methods for obtaining composite materials
10. Additive technologies for obtaining products from polymers, metals and alloys.

Section 5. Motivation

1. Experiment. How to plan, start and finish
2. Scenario of the lesson: a lifehack from a student.
3. Area of scientific interests

RECOMMENDATIONS FOR PREPARING FOR THE EXAM

Main literature:

1. Gulyaev A. P. Metallurgy: textbook for universities / A. P. Gulyaev, A. A. Gulyaev. – 7th ed., Rev. and add. – Moscow: Alliance, 2012. – 644 p.: ill. – Bibliography at the end of chapters. – Subject index: p. 637–643. – ISBN 978-5-903034-98-7. Access scheme: <http://catalog.lib.tpu.ru/catalogue/simple/document/RU%5CTPU%5Cbook%5C237275>.
2. Lakhtin Yu. M. Metallurgy and heat treatment of metals: textbook / Yu. M. Lakhtin. – 5th ed., Rev. and add. – Edit. erased. – Moscow: Alliance, 2015. – 447 p.: ill. – Bibliography: p. 443–444. – Subject index: p. 445–447. – ISBN 978-5-91872-084-4. Access scheme: <http://catalog.lib.tpu.ru/catalogue/simple/document/RU%5CTPU%5Cbook%5C340947>.
3. Zolotarevsky V.S. Mechanical properties of metals. Static tests. Laboratory workshop [Electronic resource] / Zolotarevsky V. S., Portnoy V. K., Solonin A. N., Prosviryakov A. S. – Moscow: MISIS, 2013. – 116 p. Access scheme: http://e.lanbook.com/books/element.php?pl1_id=47422.
4. Vakalova T. V. Practicum on the basics of technology of refractory non-metallic and silicate materials: textbook / T. V. Vakalova, T. A. Khabas, I. B. Revva; National Research Tomsk Polytechnic University (TPU). - 2nd ed., revised. and additional. - Tomsk: TPU Publishing House, 2013. - 176 p.: ill .. - Bibliography: p. 172-173.. Access scheme: <http://catalog.lib.tpu.ru/catalogue/simple/document/RU/TPU/book/327284>
5. Ryzhonkov D. I. Nanomaterials: textbook / D. I. Ryzhonkov, V. V. Levina, E. L. Dzidziguri — 6th ed. - Moscow: Knowledge Laboratory, 2021. - 368 p. - Text: electronic // Doe: electronic library system. - Access scheme: <https://e.lanbook.com/book/176410>

Additional literature:

1. Adaskin A.M. Materials Science and Technology of Metallic, Nonmetallic and Composite Materials: Study Guide Textbook: VO – Bachelor's degree / Moscow State Technological University "Stankin". – 1. – Moscow: FORUM Publishing House, 2019. – 400 p. – ISBN 9785000914311. Access scheme: <http://new.znanium.com/go.php?id=982105>.
2. Zemskov Yu. P. Materials science: a tutorial / Yu. P. Zemskov. – St. Petersburg: Lan, 2019. – 188 p. – ISBN 978-5-8114-3392-6. – Text: electronic // Lan: electronic library system. – URL: <https://e.lanbook.com/book/113910> – Access mode: for authorized users.
3. Dmitrenko V.P. Materials science in mechanical engineering: a tutorial / V.P. Dmitrenko, N.B. Manuylova. – Moscow: INFRA-M, 2019. – 432 p. – Text: electronic. – URL: <https://new.znanium.com/catalog/product/949728>.

Internet resources:

Professional databases and reference systems are available here <https://www.lib.tpu.ru/html/irs-and-pdb>

CREATED BY:

Zh. G. Kovalevskaya, Doctor of Technical Sciences, Professor
O. Yu. Vaulina, Ph.D., Associate Professor
G. V. Lyamina, Ph.D., Associate Professor
M.S. Petyukevich, Ph.D., Associate Professor

APPENDIX 1

APPROVED

Chairman of the examination committee

_____ / _____ /

« ____ » _____ 2024 г.

PROTOCOL

examination committee meeting

interview on

(field code, educational program)

Date _____ 2024 г.

Entrant

Full name

Members of examination committee:

Full name	Position
	chairman

Questions asked (ticket number – _____):

№ п/п	Question	Score
1.		
2.		
3.		
4.		
5.		
TOTAL, scores		

The signatures of examination committee members

Full name	Signature




With the result of the interview _____ (agree / disagree)

_____ / _____ /

(Signature)

(Full name of the applicant)

Лист согласования

Ваулина О.Ю.	Руководитель ООП Технологический дизайн	
Ковалевская Ж.Г.	Руководитель ООП Передовые материалы в нефтегазовой и нефтехимической отраслях	
Лямина Г.В.	Руководитель ООП Производство изделий из наноструктурных материалов и аддитивные технологии	
Петюкевич М.С.	Руководитель ООП Materials Science and design/ Материаловедение и разработка новых материалов (реализация программы на английском языке)	