Federal State Educational Institution of higher vocational education
NATIONAL RESEARCH TOMSK POLYTECHNIC UNIVERSITY

Director of the School of Energy and Power Engineering
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"23" 10 2020

Vice-Rector for Educational Activities
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"23" 10 2020

The program of entrance tests for the master's degree in the main educational program "Operation and engineering of nuclear power plants" in the field of training 13.04.01 Heat-Power engineering and heat engineering

Head of the main educational program Gubin V. E.

Tomsk, 2020

ANNOTATION

Master's degree program: 13.04.01 Heat and **power engineering (implementation of programs in Russian), specialization** "Operation and engineering of nuclear power plants»

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The program of entrance tests (VI) in the direction 13.04.01 Heat power Engineering and heat engineering is formed on the basis of Federal state standards of higher education (Bachelor's degree level) and is interdisciplinary in nature.

The purpose of the entrance test is to select citizens who are most capable and prepared to master the chosen program in the field of training, as well as to ensure interuniversity and inter-program mobility of bachelor's degree graduates entering the main professional educational programs of higher education at the master's level.

GENERAL REQUIREMENTS FOR APPLICANTS

FORMAT OF THE EVENT

The entrance test for persons entering the master's degree program 13.04.01 heat and Power engineering (the main educational programs implemented in English) is conducted in the form of an oral interview.

Oral conversation is conducted by the examination Committee with each incoming (entrant) individually. Applicants are asked questions that allow them to assess the level of development of basic engineering (General professional) competencies.

No more than 30 minutes are allowed for each applicant.

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

The interview with each applicant includes **4 questions** - one randomly selected question from the sections of the entrance test program- "Content of sections and topics of the entrance test program". To prepare for the VI, applicants can use the section "Recommendations for preparing for the entrance test".

The entrance test in the form of an oral interview is conducted by the examination Committee and can be organized on special platforms (in the classroom) or remotely. If necessary, the procedure for conducting the entrance test in a remote form is controlled by an observer.

On the day of the VI, applicants are allowed to enter the classroom where the VI is conducted, according to the list, in which each applicant is assigned the time of the interview.

The procedure of admission tests in remote form is subject to the documents as amended, approved by orders of the rector: the regulations on entrance examinations to master's TPU and the Order of entrance examinations.

The exam Board has the right to ask 1-2 additional questions on the subject of sections of the VI program. At the end of the interview, the Minutes of the meeting of the examination Committee are drawn up (Appendix 1) and the result is communicated to the applicant under his signature.

An applicant who does not agree with the assessment received on the VI and /or due to a violation of the VI procedure has the right to appeal. The procedure for filing and considering an appeal is regulated by the Regulations on the TPU appeal Commission in the current version, approved by the rector's order.

EVALUATION CRITERIA

The maximum total number of points for the entrance test is 100.
The minimum total number of points * confirming successful completion of the entrance test is 56.
The total number of points is defined as the sum of points for answering each of the questions, including additional ones.
The answer to each of the questions is evaluated by the exam Board separately, taking into account the following criteria::

Points	Criteria
0-7	Meaningless answer, ignorance of basic concepts, inability to apply knowledge practically.
8-14	Partially correct or insufficiently complete answer, indicating significant shortcomings of the subject; formal answers, lack of understanding of the question.
15-20	Good assimilation of the material; a fairly complete answer, independent judgments. However, there are shortcomings in the assimilation of the material and presentation that are not of a fundamental nature.
21-25	They are awarded for an informal and informed, in-depth and complete answer of a theoretical and practical nature, confirmed by the derivation of formulas, analysis, and diagramming.

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

CONTENT OF SECTIONS AND TOPICS OF THE ENTRANCE TEST PROGRAM

Section	Topics
1. Modern energy technologies	1. Current state and prospects of energy development
	2. Environmental requirements for energy facilities
	3. Load charts
	4. Resource base of modern power engineering and its problems
	5. Types of thermal and nuclear power plants
	6. Energy conversion in heat engines
	7. Steam boilers and nuclear power plants
	8. Steam turbines
	9. Gas turbine and combined cycle plants
	10. Energy balance and efficiency of thermal and nuclear power plants
	11. Technological schemes of thermal power plants and NPPs
	12. Auxiliary installations and structures of thermal and nuclear power plants
	13. Hydroelectric installations
	14. The basics of the use of water and energy, hydrology of rivers, the work of the water flow
	15. Hydrotechnical structures of hydroelectric power stations
	16. The basic power equipment of hydropower plants: hydraulic turbine and hydroelectric generators
	17. Non-traditional renewable energy resources
	18. Main types of power installations based on non-traditional renewable energy sources
	19. Promising technologies for converting raw types of energy into electricity
	20. Operating conditions of structural materials of power plants, their requirements
2. Technical thermodynamics	1. The concept of heat capacity
	2. The first law of thermodynamics
	3. The second law of thermodynamics
	4. Thermodynamics of an ideal gas
	5. Combined-cycle gas mixtures
	6. Compressor processes
	7. cycles of steam turbine units
	8. cycles of refrigeration units and thermal transformers
	9. Fundamentals of chemical thermodynamics
	10. Fundamentals of nonequilibrium thermodynamics
3. Heat and mass transfer	1. Thermal conductivity in stationary mode
	2. Intensification of heat transfer. Internal sources
	3. Non-stationary thermal conductivity
	4. Convective heat transfer
	5. Free convection
	6. Forced convection
	7. Heat exchange during phase transformations. Condensation.
	8. Heat exchange during phase transformations. Boiling point
	9. Mass transfer

	10. Heat exchange by radiation
4. Thermal and nuclear power plants	1. Current state and problems of power engineering in the field of electricity and heat production
	2. Basic requirements for energy sources: cost-effectiveness (cost, tariff, estimated costs); reliability; environmental friendliness
	3. Graphs of electrical loads
	4. Types and classification of thermal power plants
	5. Technological schemes of thermal power plants and NPPs
	6. Main equipment of thermal power plants and nuclear power plants
	7. Criteria for thermal efficiency of electric power stations
	8. Indicators of thermal efficiency of IES
	9. Indicators of thermal efficiency of CHPP
	10. Technical and economic indicators of thermal power plants and NPPs
	11. Content of the basic thermal circuit (PTS).
	12. Schemes of regenerative heating of PV.
	13. Types of regenerative heaters. Drainage drainage schemes.
	14. Deaeration of water. Henry's Law. Classification of deaerators. The scheme and the inclusion of deaerators.
	15. Feed pump switching schemes. Types of feed pump drives.
	16. Separators and intermediate superheaters of nuclear power plants.
	17. Network heaters.
	18. Requirements for the quality of the working fluid. The pathways of the contaminants.
	19. Content of the basic thermal diagram
	20. Influence of initial parameters on thermal efficiency: cycle efficiency, internal relative efficiency, conjugate parameters

RECOMMENDATIONS FOR PREPARING FOR THE ENTRANCE TEST

Basic literature:

1. Islam, M.M., Hasanuzzaman, M., Pandey, A.K., Rahim, N.A. Modern energy conversion technologies (Book Chapter, 2019) Energy for Sustainable Development: Demand, Supply, Conversion and Management, pp. 19-39. DOI: 10.1016/B978-0-12-814645-3.00002-X
2. Hasanuzzaman, M., Rahim, N.A. Energy for sustainable development: Demand, supply, conversion and management (2019) Energy for Sustainable Development: Demand, Supply, Conversion and Management, pp. 1-204. DOI: 10.1016/C2017-0-01639-7
3. Theodore, L., Ricci, F., Van Vliet, T. Thermodynamics for the Practicing Engineer (2009) Thermodynamics for the Practicing Engineer, pp. 1-414. DOI: 10.1002/9780470451595
4. Sekerka, R.F. Thermal Physics: Thermodynamics and Statistical Mechanics for Scientists and Engineers (2015) Thermal Physics: Thermodynamics and Statistical Mechanics for Scientists and Engineers, pp. 1-589. DOI: 10.1016/C2014-0-03233-9
5. Kmiec, A., Englart, S. Heat and mass transfer (2010) Spouted and Spout-Fluid Beds: Fundamentals and Applications, 9780521517973, pp. 161-174. DOI: 10.1017/CBO9780511777936.010
6. Pioro, I., Duffey, R. Current status of electricity generation in the world and future of nuclear power industry (Book Chapter, 2018) Managing Global Warming: An Interface of Technology and Human Issues, pp. 67-114. DOI: 10.1016/B978-0-12-814104-5.00003-X
7. Ohji, A., Haraguchi, M. Steam turbine cycles and cycle design optimization: The Rankine cycle, thermal power cycles, and IGCC power plants (2017) Advances in Steam Turbines for Modern Power Plants, pp. 11-40. DOI: 10.1016/B978-0-08-100314-5.00002-6
8. Zohuri, B. Thermal-hydraulic analysis of nuclear reactors: Second edition (2017) Thermal-Hydraulic Analysis of Nuclear Reactors: Second Edition, pp. 1-835. DOI: 10.1007/978-3-319-53829-7
9. Sarkar, D.K. Thermal Power Plant: Design and Operation (2015) Thermal Power Plant: Design and Operation, pp. 1-584. DOI: 10.1016/C2014-0-00536-9
10. Liu, X., Bansal, R. Thermal power plants: Modeling, control, and efficiency improvement (2016) Thermal Power Plants: Modeling, Control, and Efficiency Improvement, pp. 1-303. DOI: 10.1201/9781315371467

Additional literature:

1. Ferret, E., Bazinet, L., Voilley, A. Heat and mass transfers-basics enthalpies calculation and the different transfer modes (Book Chapter, 2019) Gases in Agro-food Processes, pp. 89-102. DOI: 10.1016/B978-0-12-812465-9.00008-6
2. Johnson, S.C., Todd Davidson, F., Rhodes, J.D., Coleman, J.L., Bragg-Sitton, S.M., Dufek, E.J., Webber, M.E. Selecting favorable energy storage technologies for Nuclear power (2018) Storage and Hybridization of Nuclear Energy: Techno-economic Integration of Renewable and Nuclear Energy, pp. 119-175. DOI: 10.1016/B978-0-12-813975-2.00005-3
3. Chen, Z. An overview of power electronic converter technology for renewable energy systems (Book Chapter, 2013) Electrical Drives for Direct Drive Renewable Energy Systems, pp. 80-105. DOI: 10.1533/9780857097491.1.80.
4. Kulyk, M., Zgurovets, O. Modeling of Power Systems with Wind, Solar Power Plants and Energy Storage (Book Chapter, 2020) Studies in Systems, Decision and Control, 298, pp. 231-245. DOI: 10.1007/978-3-030-48583-2_15
5. Sarkar, D.K. Thermal Power Plant: Pre-Operational Activities (2016) Thermal Power Plant: Pre-Operational Activities, pp. 1-440.

Online resources:

1. SCOPUS database https://www.scopus.com
2. База данныхWeb of Science database www.webofknowledge.com
3. Scientific and technical library of TPU. https://www.lib.tpu.ru/

The DRAFTERS:

V. E. Gubin, Ph. D.
S. V. Lavrinenko, Ph. D.

APPENDIX 1

Approving IT
Chairman of the examination Board
_____/_____/

"____" _____20__ city of

PROTOCOL
the meeting of the examination Committee

interview _____
_____
(referral code, educational program)

Date of the event ____ _____ 20___ city of

Incoming user

FCS

The composition of the Commission:

Full name	**Position**
	Chairman of the Commission

Questions asked (ticket number – _____):

Number	**Question**	**Score**
1.		
2.		
3.		
4.		
5.		
	TOTAL, point (s)	

Signatures of Commission members

Full name	Signature

With the result of the interview _____ **(I agree/ I don't agree)**
_____/_____/
(signature) (Full name of the applicant)