Entrance tests

1. Energy resources and the fuel and energy industry. Energy production efficiency.
2. Thermal engineering measurements in heat-power engineering. Control, registration and regulation in heat power systems.
3. Basic thermodynamic parameters of the state as well as their measurement methods and units.
4. Basic gas laws. Ideal gas law.
5. Equations and graphs of the basic thermodynamic processes of an ideal gas.
6. How is the concept of enthalpy introduced in thermodynamics? How does enthalpy change during throttling?
7. The first law of thermodynamics and its recording through internal energy and enthalpy.
8. Equation of the first law of thermodynamics for a flow.
9. What is the thermal capacity? What is the thermal capacity in the adiabatic process?
10. The relationship between the specific thermal capacities of an ideal gas at P = const and V = const.
11. Give one of the formulations of the second law of thermodynamics. Give its mathematical notation.
12. The principle of the perpetual-motion machines of the 1^{st} and 2^{nd} kind.
13. Depict the process of gas compression in the compressor in P-V and T-S coordinates.
14. What is surging and how to avoid it?
15. What are the intermediate and end coolers in the compressor for?
16. In what cases and for what is the Laval nozzle used?
17. The Carnot cycle and its efficiency.
18. The cycle of a gas-turbine power unit. What does its efficiency depend on?
19. The Rankine cycle on the superheated steam and its efficiency.
20. Ways to improve fuel efficiency in the Rankine cycle.
21. What is the CCGT (combined cycle gas turbine) cycle? What are its advantages?
22. The main ways to distribute heat.
23. The Fourier law is the fundamental law of thermal conductivity.
24. What is the thermal conductivity coefficient, its dimension. What does its magnitude depend on? Where is it taken to perform calculations? The order of magnitude of the thermal conductivity coefficient for various substances?
25. Types of convection and how are they different?
26. The basic equation of convective heat transfer is Newton's equation.
27. What is the heat transfer coefficient, its dimension, how to determine it for performing calculations?
28. What does the heat transfer coefficient depend on by convection?
29. What is the heat transfer coefficient and what does it depend on?
30. The Stefan-Boltzmann law.
31. How to calculate the heat flow by the thermal conductivity through a flat wall?
32. How to calculate the heat flow through a multi-layered flat wall?
33. What is thermal resistance? Calculate the thermal resistance of heat transfer through a flat wall.
34. What is the thermal resistance of heat transfer through the multi-layered wall?
35. The concept of thermal resistance in the case of heat transfer, thermal conductivity and heat transfer.
36. Heat exchange while liquid boiling.
37. Heat exchange during steam condensation.
38. Physical basis for the nuclear power reactors functioning. The fission reaction. Delayed and instantaneous neutrons. The neutron multiplication factor, reactivity.

39. Neutron lifetime. The period of reactor overclocking. The subcritical, critical and supercritical state of the reactor.
40. The core, reflector, nuclear fuel. The effects and coefficients of reactivity. The temperature, power, steam effects of reactivity. Poisoning the reactor with xenon and samarium. Burnout and reproduction of the nuclear fuel.
41. Reactivity methods and regulators. Fuel-element lifetime, overload.
42. Starting the reactor, operation at power, stop. Automatic power control. Self-regulation of the reactor.
43. Emergency protection of the reactor.
44. Emergency cooling systems for reactors.
45. Accident localisation systems. The defence in depth strategy. The levels of delay in release of radioactivity into the environment.
46. Passive safety systems. Safety inherent in the core based on the laws of nature. The natural safety of reactors and the nuclear fuel cycle.
47. Single-circuit, two-circuit and three-circuit schemes of nuclear power plants. The designs and thermo-physical features of nuclear reactors PWR, BWR, RBMK, HTGR, AGR and CANDU.
48. Intra-corporeal devices of nuclear power plants. The witness samples of the reactor vessel steel. The principle of natural circulation of a coolant in boiling reactors.
49. Security barriers. The installed capacity use coefficient. The design of fuel assemblies for various types of nuclear power plants.
50. A cartogram for loading the nuclear power plant's core. Fuel overload.
51. Types of ionising radiation. The absorbed, exposure, equivalent doses of ionising radiation. The ionising radiation quality factor. The biological effect of the ionising radiation. The somatic, somatic-stochastic and genetic effects of irradiation.
52. Methods for recording and dosimetry of the ionising radiation. Methods for recording neutrons.
53. The linear and mass range of a particle in a substance. The half-value layer.
54. The radiation safety standards. The categories of persons being irradiated. The increased exposure planned.
55. Radioactive aerosols and gases at nuclear power plants. Devices for dosimetric and special process monitoring at nuclear power plants.
56. Industrial energy carriers, their properties and applications in heat and mass transfer processes.
57. The methods of experimental study of heat and mass transfer processes. Modelling methods.
58. The thermo-physical experiment and methods for processing the experimental data. Experiment planning elements. Automation systems for the experimental research.
59.The heat balance of a boiler. Approximate values of the main losses.
60. Boiler efficiency by direct balance.
61. Boiler efficiency by the reverse balance.
62. What is the available heat of the fuel?
63. The calorific value $Q_{н}^{р}$ and $Q_{в.м}^{г}$. How are they determined?
64. What is a conventional fuel?
65. How is the enthalpy of combustion products calculated?
66. How does the coefficient of excess air affect the losses in the boiler unit?
67. How does the excess air coefficient affect the theoretical combustion temperature?
68. How does the boiler load affect the losses in the boiler unit?
69. How does the increase in air suction on the fuel-utilisation device affect the efficiency of the unit?
70. What are the concentration limits of flame propagation for a natural gas-air mixture?
71. What are the main operational parameters that determine the specific thermal stresses of the combustion mirror and the volume of the furnace?
72. Due to what is the driving force of natural circulation?
73. What is the circulation rate?

74. Types of super-heaters by the nature of the heat-absorption efficiency.
75. Methods for controlling the temperature of superheated steam in steam boilers.
76. Which surfaces of a boiler are considered low-temperature?
77. Methods designed to reduce the low-temperature corrosion of air heaters.
78. List the harmful emissions from the boiler and indicate the methods for reducing them.
79. What can lead the flame failure in the furnace of a boiler to?
80. How will an increase in the rate of flue gases influence the operation of an electrostatic precipitator and a cyclone?
81. The main ways to reduce the concentration of nitrogen oxides in combustion products?
82. The reactors and steam generators of nuclear power plants. Technological energy carriers of nuclear power plants.
83. Water regime, chemical control and water treatment at CHP-plants and nuclear power plants. Water treatment installations and systems in industry.
84. Steam-turbine installations. Application in industrial heat power engineering.
85. Gas-turbine and combined plants. Application in industrial heat power engineering.
86. Pumps, exhaust and draft units. Application in industrial heat power engineering.
87. Solar power plants. The characteristics of solar radiation. Solar photoelectric converters. Design of a photoelectric converter. Methods for obtaining the ‘solar’ silicon. Heterostructures. Solar collectors. Solar power plants.
88. Geothermal power engineering. Thermal regime of the earth's crust. Deposits of geothermal sources. Geothermal power plants.
89. Wind power. Wind power resources. Types of wind power converters. Wind power plants.
90. Small hydropower. Classification of small hydropower plants and hydroelectric units. Ways to create head.
91. Industrial heat and mass transfer apparatus and installations. Application in industrial heat power engineering.
92. Industrial refrigeration systems and systems. Low-temperature and cryogenic processes and installations. Application in industrial heat power engineering.
93. Water supply systems for industrial enterprises.
94. Air supply systems for industrial enterprises.
95. Gas supply systems for industrial enterprises.
96. Energy and environmental protection in industrial heat and power engineering.