Energy Technologies (I st.) - questions for diploma exam

Academic Year 2023/2024

1. Basic definitions concerning energy, heat, work and power.
2. Mathematical formula/expression of 1st Law of Thermodynamics for open systems.
3. Mathematical formula/expression of 1st Law of Thermodynamics for closed systems
4. Thermal equation of state.
5. Calorific equations of state.
6. Thermodynamic processes of ideal gases.
7. Mathematical and verbal formula/expression of second Law of Thermodynamics.
8. Carnot cycle.
9. Engine thermodynamic cycles.
10. Clausius-Rankine cycle.
11. Methods of improving the efficiency of Clausius-Rankine cycle.
12. Brayton cycle.
13. Refrigeration thermodynamic cycle.
14. Compressor heat pump thermodynamic cycle.
15. Mechanisms of heat transfer.
16. Basic moist air processes.
17. Energy balance of piston engine.
18. Fluid as a model for the liquid and gas.
19. Models of fluid.
20. The basic equations for the behavior of one-dimensional model.
21. Bernoulli equation.
22. The special conservation equations within the model one-dimensional.
23. Balance of entropy.
24. Forces on a plane surface.
25. Forces on a curved surface.
26. Vortex motion of fluid.
27. Navier-Stokes equation.
28. Laminar and turbulent flows in pipes.
29. Definition and physical meaning of Reynolds number.
30. Laminar and turbulent boundary layers.
31. Flows in open and closed channels.
32. Archimedes' law.
33. Theory of turbine stages.
34. Natural convection in single-phase fluid.
35. Fourier's law.
36. Definition and physical meaning of Nusselt number.
37. Absorptivity. Blackbody definition.
38. Stefan's law.
39. Planck's law.
40. Classification of heat exchangers.
41. Principle of operation of a heat pipe.
42. What is the principle of sustainable development?
43. Generation structure of the national energy system.

44. List the most important pollutants emitted into the atmosphere by burning fossil fuels.
45. Give some examples of techniques used in the clean-burning boilers.
46. What is a trading system for CO_2 emissions?
47. Long term risks and risk management.
48. Physical properties of renewable sources.
49. Classification of hydro power plants and their advantages.
50. Types of geothermal sources and scheme of the binary power plant.
51. OTEC system.
52. Features of wind/electricity generating systems.
53. The term of cogeneration.
54. The term of trigeneration.
55. Distributed energy system.
56. Design and use of the combined power and heat energy systems.
57. The construction of combustion engines and compressors.
58. The use of renewable fuels in distributed energy systems.
59. Nuclear power plants with PWR and BWR.
60. Methods of improving the efficiency of gas turbine power plant.
61. Principles of balancing various energy facilities.
62. Principles of rational use of energy.
63. Open and short-circuit test of transformers.
64. Equivalent circuit of induction motor.
65. Generator volt-ampere characteristic.
66. Characteristics of semiconductor devices as power electronics switches.
67. Construction and operation principle of diode rectifiers.
68. Structure and operating principle of the selected pulsed DC-DC converter.
69. Construction and operation of the voltage inverter.
70. The impact of power electronic converters on the power grid.
71. Improving the quality of electricity through the use of a power electronic converter.
72. Causes of error: systematic, random. Ways to reduce these errors.
73. How to estimate the uncertainty of measurement?
74. Derive the scheme and the way of balancing the Wheatstone bridge.
75. Active and reactive power measurement systems in a three-phase four-wire system.
76. Give the characteristics of metals and metal alloys.
77. What is the hardening of steel?
78. Give the definitions of basic copper alloys.
79. Discuss the Human - Machine - Environment System.
80. Properties of fuels used on sea-going vessels.
81. Advantages or disadvantages of fossil fuel.
82. Advantages or disadvantages of renewable energy.
83. Possible sources of air pollution.
84. Define the parameters characterize the geometric structure of the surface.
85. Explain meaning of the datum in the manufacturing process.
86. Describe the method of manufacture of plastics components.
87. Characterize the materials used on the tool cutting edges in relation to the cutting speed.
88. Discuss the methods of producing precise gears.

89. Describe the finishing methods using for hard material smachining (> 40 Rockwell grade).
90. Energy storage systems.
91. Types of geothermal sources and scheme of the power plant powered by this source.
92. Environmental, climate and social issues and impact on hydropower development.
93. Operating Parameters and hydraulic turbine performance characteristics.
94. Types of pumps and their working principles.
95. Types of engineering stress.
96. Evaluation of component stresses.
97. Evaluation of equivalent stress.
98. Allowable stress.
99. Friction in mechanical engineering.
100. Evaluation of reaction forces in static cases.