Mechanical Engineering, undergraduate studies
specialization: Design and Production Engineering - questions for diploma exam
Academic Year 2023/2024

1. Equilibrium conditions of a force system
2. Ideal and real constraints and their reactions
3. Solids dynamics equations
4. Principles of mechanics: momentum and impulse, energy and work, angular momentum and angular impulse
5. Friction and rolling resistance
6. Simple and complex strain condition
7. Thermal and assembly straining
8. Fatigue strength of materials
9. Material strength hypotheses
10. Surface buckling
11. Characteristics of the four groups of construction materials
12. Definition, characteristics and applications of steel
13. Definition, characteristics and applications of cast iron
14. Types and applications of aluminium alloys
15. Types and applications of copper alloys
16. Phase diagrams of metal alloys
17. Thermal processing: basic types
18. Thermo-chemical processing: basic types
19. Principal methods of examination and research of materials
20. Characteristics of the forms of materials destruction
21. Shaping the properties of a material through plastic working
22. Methods of the dislocation of atoms in solid bodies
23. Characteristics of the basic properties of materials
24. Structure of ceramic materials
25. Production and shaping of ceramics
26. Isothermal transformation diagrams
27. Electrical properties of materials
28. List factors that are taken into consideration when selecting the values of the factor of safety
29. Determining the permissible strains at constant and variable loads
30. Method of calculating fitted bolts and through bolts when joint is loaded with force acting at the plane of contact of joined elements
31. The influence of the stiffness of elements on the behaviour of a bolted joint loaded perpendicularly to the contact surface with variable loads
32. Types of joints between a shaft and a wheel hub assembly, advantages and disadvantages of particular joints
33. Main functions of resilient elements in mechanical devices, provide and discuss the examples
34. Methods of the realization of smooth friction in slide bearings

35. Rolling bearings – types, characteristic features, selection methods, determining the durability
36. Types of mechanical gearboxes, principles of application and characteristic features
37. Gear with involute teeth – characteristic features and geometrical parameters of the gear
38. Distribution of forces in a gearbox with straight and helical teeth
39. Calculation models of fillet and butt joints
40. Beneficial and adverse role of friction in mechanical systems - examples
41. Calculation model and design method of a coil spring
42. Centrifugal couplings – their role in a drive train, examples of construction (sketch)
43. Flexible couplings – their role in a drive train, examples of construction (sketches)
44. Rigid couplings - their role in a drive train, examples of construction (sketches)
45. Initial strain in taper roller bearing systems – role, realization methods, effect on the durability of a system
46. Potential forms of damaging a parallel key vs calculation model of a keyway connection
47. Advantages and disadvantages of sliding bearings with smooth friction as compared with sliding bearings
48. Thermal equation of the condition of a perfect gas
49. Caloric equation of the condition of a perfect gas
50. First law of thermodynamics
51. Second law of thermodynamics
52. Transformations of a perfect gas
53. Carnot cycle and its efficiency
54. Comparative thermodynamic cycles of thermal motors
55. Thermodynamic cycle of a compressor refrigerator
56. Thermodynamic cycle of a compressor heat pump
57. Thermodynamic cycle of a steam power plant
58. Methods of increasing the efficiency of Clasius-Rankine cycle
59. Isobaric process of humidifying a dry gas
60. Parameters characterizing a humid gas
61. Processing of air in thermal comfort applications
62. Heat exchange mechanisms
63. Thermal and electrical analogy in issues related to heat exchange
64. Combustion heat and calorific value of fuels
65. Bernoulli's principle
66. Methods of determining the losses in pipelines
67. Design for manufacturability of machine part construction
68. Flexible manufacturing systems
69. Methods of shaping the surface in machining
70. Quality assessment criteria of a product in a technological process
71. Fine machining methods and their significance in machine construction

72. Computer-aided design of technological processes using CAD/CAM/CAE systems
73. The influence of the serial production of goods on the degree of automation (robotization) of manufacturing processes
74. The meaning of the rigidity of a working system MCWT (Machine tool, Chuck, Workpiece, Tool) in fine machining
75. The principle of the database redundancy in machine technology
76. Selecting the methods of manufacturing of machines with the ecological criteria in mind
77. Bonding processes
78. Weldability of steel, cast iron and cast steel
79. Methods of arc welding of metals
80. Characteristics of the basic methods of welding of metals
81. Thermal cycle of welding
82. Welding strains and deformations
83. Welding imperfections
84. Methods of assessing the quality of welded joints
85. Methods of repair of welded structures
86. Performance cracking of welded joints
87. Construction of welding devices
88. Manufacturing techniques of cast machine parts
89. Characteristics of the processes of plastic processing
90. Causes and effects of emitting harmful substances into the atmosphere
91. Mechanical methods of purification and renewal of water
92. Methods of examining and researching ecological losses and benefits
93. The definition, classification and basic properties of biomaterials
94. Classification of protective coatings
95. Energy storage systems
96. Components of hydropower plant and their functions
97. Operating parameters and performance characteristics of hydraulic turbine
98. Types of pumps and their working principles
99. Effect of using fossil fuels on climate change
100. List of natural energy resources and describe it benefits of using