Zestaw pytań na egzamin dyplomowy – MECHANICAL ENGINEERING AND MACHINE BUILDING – I stopień

Komisja egzaminów dyplomowych może zadawać pytania nie ujęte w podanych zestawach zagadnień mieszczące się w kanonie wiedzy danego stopnia studiów i kierunku studiów.

Group A. MECHANICS, STRENGTH OF MATERIALS, MATERIALS SCIENCE

1. What is the moment of the force F with respect to the point O?
2. What are the equilibrium conditions the reactions in supports of the statistically determinable systems are determined of?
3. What is the main vector and main moment?
4. What is the bending moment and shear force, how they are determined?
5. What the Ritter method consists in, give an example of application.
6. What is the mass centre in the multi-mass systems and what are the static moments?
7. What are the geometrical moments of inertia?
8. What is the inertia moment and what it is determined for?
9. What are the moments of deviation?
10. What physical quantities describe the move of a material point and how they are defined?
11. What is the tangential and normal acceleration?
12. Principle of mechanical energy conservation.
13. Principle of momentum conservation and of angular momentum conservation.
14. Discuss the concept of strength and rigidity condition at the example of tension or torsion.
15. Explain the distinction between ductile and brittle structural materials.
16. Discuss the concept of safety factor. Specify several factors influencing its value.
17. Discuss the stress state in a thin-wall cylindrical vessel loaded with internal pressure.
18. Discuss the conditions set in calculating the strength of riveted joints.
19. Discuss the Huber hypothesis at an example of verifying the strength of a shaft carrying the bending and twisting moments.
20. Elasticity constants of an isotropic material. How the Poisson's ratio and Young's modulus can be determined experimentally?
21. Discuss the phenomenon of structural materials fatigue.
22. Discuss the phenomenon of creep and relaxation in structural materials.
23. At an example of compressed bars explain the phenomenon of stability loss.
24. Discuss the patterns of normal and tangential stresses in a beam bended with transverse force.
25. Energy methods – give an example of application for calculating displacements and solving the statically indeterminable systems.
26. Basic groups of engineering materials and types of inter-atomic bonds.
27. Point defects in crystals of metals, types, formation and disappearance, influence on properties.
28. Dislocations, types, influence on strength properties of metals and quantities characteristic for them.
29. Crystallization of an ingot, course of the process. Crystalline zones.
30. Transformations during heating of crushed metals, properties change.
31. Solid solutions, types, influence of dissolved component at their properties.
32. Fe-Fe3C diagrams, phases and structures present and their properties.
33. Unalloyed steels, divisions and designation ways.
34. Carbon influence on steel properties.
35. Grey cast irons, graphite types, division rules and designations.
36. Malleable cast irons, receiving, division and designations, properties.
37. Spheroidal cast irons, receiving, division, designation, structures, properties.
38. Fine- and coarse-grained steels, obtaining the fine-granularity, influence of grain size on properties.
39. Martensite, its build and properties, carbon impact.
40. Tempering types, structures and influence on properties.

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Group B. CONSTRUCTIONS – Fundamentals of Machine Design (PKM), Theory of Machines and Mechanisms (TMM)

1. Description of the heuristic methods of generating alternatives for technological problem solving.
2. Way of morphological tables building at generating alternative solutions. Give examples.
3. Discuss the methods of selecting the optimal alternative of technical task solution.
4. Kinematic pairs: definition, classification.
5. Rational and irrational systems (passive constrains).
6. Compounds of the acceleration vector for two points of one member in plane motion.
7. Mechanism positions description using vector and algebra equations.
8. Manipulator: simple and reverse task in kinematics and dynamics
9. Define the real safety factor δ and illustrate it at the simplified Haigh diagram.
10. The resultant inertia force of a member in plane motion.
11. Statically determinable group.
12. Friction in the cam and rotation pair (friction wheel)
13. Describe the Haigh fatigue diagram building and explain its usefulness in the machine design process.
14. Name the design features and discuss them.
15. Name the designing principles and interpret them.
16. Allowable stress „k", the way of determining its value at static and dynamic loads. Give examples.
17. The factors influencing fatigue strength of machine parts and the way of considering them in design calculations.
18. Specify the elements to be considered by safety factor (xRe, xRm, xZ), the value of which is assumed a priori, in determining the allowable stress values „k".
19. The self-locking condition of a screw joint and its illustration at the inclined plane (uncoiling of one convolution).
20. Specify the necessary conditions for the uniformity of pressures between the convolutions of screw and nut.
21. Flexible screw joint, its essence and work diagram.
22. Draw the cross-section of a key joint in a gear wheel hub with shaft and discuss the principle of the key fitting and its selecting.
23. Specify the method of welded joints calculation at the example of two sheets joined with the butt weld subjected to the single-sided tensile load cycles.
24. Stresses in the cylindrical helical spring and the method of their consideration in the spring design calculations.
25. Name and discuss the criteria to be met by a machine shaft.
26. Vibrations of shafts, the phenomenon of resonance.
27. Principles of machine shafts forming and methods of axial fixing of parts assembled on them.
28. Elastic slip in the belt of a belt transmission – its origins and impact on the transmission operation.
29. Explain the cause for ratio instability in a belt transmission.
30. The universal (Cardan) coupling, its build and the way of removing the rotational speed pulsation.
31. Rigid and flexible permanent couplings, characteristics and examples of structural solutions.
32. Characteristics of the involute and cycloidal gear tooth profiles.
33. Selection criteria for rolling bearings.
34. The principle of bearing and its illustration at the example of bi-support shaft.
35. The principle of rolling bearing fit, illustration of the d, D and B dimensions toleration in a bearing.
36. Geometry of gear wheels (base circle, pitch circle, generating circle, addendum and dedendum circle, module, pitch, transverse pressure (outline) angle, pressure angle, line and section of pressure, tooth contact ratio)
37. Correction of gear wheels – types and their characteristics.

38. Describe the planetary gears build and their properties.
39. Description of strength calculation models for gear wheels (Niemann and Lewis).
40. Irregularity of a machine run: causes, the flywheel.

Group C. TECHNOLOGIES, METROLOGY

1. Materials used in casting moulds manufacturing.
2. Name the elements of foundry equipment.
3. What properties should have the casting alloys?
4. Methods of manufacturing the machine casting moulds.
5. Methods of castings production in metal moulds.
6. Basic functional assemblies in the machining tools.
7. Basic movements in the machining tools.
8. Machine diagnostics methods (efficiency, powers loses, noise, vibrations).
9. Basic physical quantities featuring lubricants.
10. Phenomena in the material strained plastically.
11. Discuss the processes of forging, extruding and rolling.
12. What is the yield stress?
13. Difference between cold and hot plastic working.
14. Methods of obtaining, properties and application of copper and its alloys.
15. Impact test, how it is performed.
16. Division of plastic working methods.
17. Comparison of the forging methods in the half die (open) and closed die.
18. Extrusion methods of metals and alloys
19. Explain the essence of the plastic strain of metals.
20. Role of the friction in the plastic working processes.
21. The work-hardening curve – ways of determining and factors influencing the yield stress.
22. The methods of rolling, products and technological parameters of the process.
23. Electrodischarge machinning.
24. The tool materials used in machining.
25. Methods of making threads.
26. Methods of forming the gear wheels.
27. Protective coatings on the cutting tool edges.
28. What is the hardness and what methods it is measured with?
29. What is the difference between steel, cast steel and cast iron?
30. Draw and describe the stress-strain curves for steel with physical and offset yield point.
31. Methods of obtaining aluminium, properties and application of aluminium and its alloys.
32. What non-destructive testing methods are used for detecting the internal defects?
33. What is the heat affected zone and what is its impact on the welded joints properties?
34. What welding methods are used for the thin metal sheets and what for the thick ones?
35. What pressure welding methods are used for joining the metal sheets and what for the rods?
36. What is the difference between soft and hard soldering? The mechanism of creating a joint in the soft and hard soldering.
37. The heat sources used in the welding methods.
38. Specify the differences between the MAG (metal active gas) and MIG (metal inert gas) arc welding methods in the protective gas shielding, and the application of these methods.
39. The TIG (tungsten inert gas) welding process.
40. What is the pressure welding, name the known methods.