

Zestaw pytań/zagadnień na egzamin dyplomowy

Kierunek MBM, II stopień, specjalność Automotive Engineering, studia w języku angielskim
Mechanical Engineering and Machine Building/AE – II stopień

Group of problems main prob

1. Discuss the principle of virtual works.
2. Discuss the equations of the planar motion a rigid body (derivation from the general equation of dynamics)
3. Discuss kinematics of rotation about a fixed point.
4. Discuss the application of the type II Lagrange equations.
5. Discuss the free vibrations in mechanical systems, forms of vibrations and resonance frequencies.
6. Strengthening mechanisms and effects of their application at the example of selected aluminium alloys.
7. Strengthening mechanisms and effects of their application at the example of selected copper alloys.
8. Discuss alloy micro additions and their role in modern high-strength low-alloy steels (HSLA).
9. Types and parameters of reinforcement and influence on the composites properties?
10. When the classic strength, and when the brittle cracking mechanics or the mesomechanics of slip cracking are applied? Based at what material parameters we determine the need for applying cracking mechanics?
11. What is the difference between brittle cracking of crack-free materials and those with cracks? Which case is?
12. Technical and operational characteristics of machine tools.
13. Specific requirements for main motion drives.
14. Characteristic features and designation of basic machine tool types.
15. Machines and equipment in automatic casting lines.
16. Division of power presses, their basic sizes and structural features.
17. Equipment for welding with consumable and nonconsumable electrodes – principle of operation.
18. Resistive and friction welding machines – characteristics.
19. Functions of robots at automatic assembly lines.
20. Describe process of high-speed cutting.
21. Principle of laser device operation.
22. What experimental methods for strain analysis do you know?
23. Give examples of computer systems for dynamic analysis and discuss their calculation capacities.
24. Describe a procedure of building a numerical model of mechanism.
25. Give reasons for calculating mobility (degrees of freedom) for a multi-member system before initiating building.
26. What is PLC and what are its applications?
27. What is CNC and what is its designation?
28. Discuss the waveform of signals in hydrostatic systems controlled by proportional hydraulic components.
29. What is the idea of LS (load sensing) control in the machines with hydrostatic drive?

30. Types of locomotion in land vehicles: examples, advantages and disadvantages, the analogies in nature.
31. Show the impact of limb length and step length on energy consumption in walking motion.
32. Using the axioms in mechanics show why a vehicle is moving.
33. The problem of wheel rolling resistance, definitions, qualitative impact of factors at rolling resistance.
34. Definition of the driven wheel and breaking wheel slide.
35. Discuss the oversteering and understeering of a vehicle.
36. Differential gear, types, its kinematics and dynamics.
37. Steering systems in vehicles: without servo, with partial servo and with full servo – examples and simplified.
38. Advantages and disadvantages of wheel and caterpillar chassis.
39. Resistance to motion and traction forces of a caterpillar vehicle in relation to a wheel vehicle with two-axis.

Specialty Questions-Automotive Engineering

1. How to identify the vehicle? Name the elements of the appraisal opinion about the car.
2. Show main structural and functional components in vehicle.
3. Please make a physical model of the vehicle, taking into account the characteristic masses and weight relationships between them.
4. Please conduct an analysis of the vehicle motion from the moment of making the decision to brake from the initial speed of $v=50$ km/h on a dry asphalt surface until the vehicle stops.
5. Describe all the resistances influencing the movement of the car that occur during its operation.
6. What are the main ways to improve the aerodynamics of the vehicle, especially under its body?
7. What is a tire sideslip angle? Draw a schematic diagram of tire sideslip and explain what it depends on?
8. What does the equivalent energy speed parameter describe in the appraisal technique?
9. What are the active and passive safety features in vehicles?
10. Why does a transmission in the car have to be used ?
11. How are vehicle suspension systems classified?
12. How does an electronically controlled dual clutch work ?
13. How does Electronic Stability Programme (ESP) work?
14. What does Anti-Slip Regulation (ASR) mean on the vehicle?
15. What does Electronic Braking System (EBS) mean on the car?
16. Explain the principle of energy recovery in a car.
17. How does the second law of thermodynamics affect the operation of an internal combustion engine?
18. Describe the process of normal combustion in a spark-ignition engine, showing all stages using a pressure-volume diagram.
19. Describe the process of normal combustion in a diesel engine, showing all stages using a pressure-volume diagram.
20. Present in graphical form and describe the valve timing in high-efficiency internal combustion engines.
21. Describe in detail the brake specific fuel consumption parameter in against the background of the performance map of the internal combustion engine.
22. Make decomposition of internal combustion engine to show a lubricating system.

23. Characterize the materials used in the production of the elements of the piston-rings-cylinder liner system.
24. List the filtration mechanisms used in engine air filters.
25. Explain the idea of using the VarioCam system.
26. Show the advantages of the Common Rail system.
27. Why are engines noisy and how can the noise be reduced ?
28. Show the trends in IC engine technology to improve efficiency.
29. Discuss the direct and indirect impact of motorization on the environment.
30. What are toxic components of the IC engine exhausts? Describe the causes of their forming in the combustion chamber.
31. What will the legislative measures in the European Union be regarding to new car CO₂ emissions?
32. List primary and secondary methods of reducing toxic emissions from internal combustion engines.
33. Emission vs. concentration - explain the terms in the context of environmental protection in transportation and give examples of units.
34. You work in the research and development center of a truck engine factory. What solutions will you propose to reduce NO_x emissions from engines?
35. List the main properties of liquid engines fuels and characterize them.
36. What is difference between Cetane index and Cetane number?
37. Describe the path of End-of-Life Vehicle (ELV) recycling.
38. Explain, why After Shredding Residues (ASRs) is the weak point of End-of Life Vehicles (ELV) recycling ?
39. Present the characteristics of process of charge and discharge of battery and ultracapacitor.
40. Present and describe output waveform of voltage and current of two pulse controlled rectifier with the load RL (a resistor-inductor circuit).
41. Present waveform of output current of chopper, mark the current of thyristor and freewheeling diode.
42. What is the difference between Negative Temperature Coefficient (NTC) and Positive Temperature Coefficient (PTC) thermistors?
43. Describe the structure of the Controller Area Network (CAN) bus.
44. Show differences between (Controller Area Network) CAN 2.0A and 2.0B standards.
45. Describe the structure of the Local Interconnect Network (LIN) bus.
46. Describe the structure of the Media Oriented Systems Transport (MOST) bus.
47. What is the different between bus and star topology?
48. Describe half and full duplex communications.
49. What does a car Heads-Up Display (HUD) work?
50. Why knock sensor is so important and how it works?
51. What are the main differences between narrowband and wideband lambda sensors?
52. Does a Series Hybrid Electric Vehicle need to be equipped with a starter motor? Explain with a diagram.
53. Characterize the Parallel Hybrid drive-train in vehicle.
54. Point out the advantages and disadvantages of the Hybrid Synergy Drive (HSD) in relation to the overall efficiency of the car.
55. Discuss pros and cons of electric cars in the context of Life Cycle Assessment (LCA).
56. What is the base value of the vehicle and how is it determined?
57. Give the areas of knowledge according to Project Management Body Knowledge.
58. Discuss scheduling when managing a project with top-down and bottom-up methods.
59. Show and describe the motivation factors for effective work.
60. Discuss the PESTEL methodology indicators on the example of the implementation of a selected alternative fuel.

