Control Systems of Mechatronic Systems

Study programme: N0714A270004 Mechatronics
Academic year: 2024/2025

1. Requirements on the microcomputers control systems of mechatronic systems. Control block scheme one and multi-processor system. HW part of microcomputer.

2. Sensors in mechatronic systems – current, voltage, rotational speed, rotation angle, position.

3. Develop systems for application software. Programme unit composition, couplings, computer processing distribution. Communication with upper-level control system. Serial interface.

4. Describe the basic principles and functions of industrial robot control, coordinate systems, motion modes, operating modes, also explain the TCP and the procedure for manual tool definition.

5. What is the purpose of creating a motion simulation of an industrial robot, what can be gained from the simulation, what a digital twin is and what it is used for?

6. Describe the basic safety principles and safety devices used in industrial automation and robotics.

7. Present trends in robot and mechatronic system design.

8. Requirements on semiconductor converters of mechatronics systems, power requirements, amplification and dynamics of converter, basic types of converters.

9. Controlled rectifiers, their connection schemes and operating principles. Properties when supplying a DC motor. Static and dynamic properties of controlled rectifier.

10. DC/DC converters (choppers) - converters for voltage increasing and decreasing, their connection schemes and operating principle. 2-quadrant and 4-quadrant DC/DC converters. Properties when supplying a DC motor. Control methods of DC/DC converters. Static and dynamic properties of DC/DC converters.

11. Voltage inverters (1-phase and 3-phase), their connection schemes and operating principles. Properties when supplying the load with R, serial R-L character and general motor (R-L-Ui). The effect of zero diodes on the behaviour of voltage inverters.

12. Control methods of the inverter output voltage. Reason to control the size of the output voltage. Comparative and vector modulation of the inverter output voltage. Two-level output current control.

13. Indirect frequency converters, their structures, basic blocks and properties. 4- Quadrant mode of indirect frequency converters with voltage inverter

14. Switching semiconductor components for power semiconductor converters, classification. Properties of different structures and suitability for use in various types of converters.

15. Basic structures of the hydraulic circuit, system parameters, control elements, hydro motors, operational properties, control options.

16. Control of hydraulic drives, hydraulic motor, and cylinders, the basic structure of controlled hydraulic circuits, directional valves - proportional valves, servo valves, valve characteristics, properties and characteristics of hydro motors.

17. Position control loop - position servomechanism elements, block diagram, modes of control. Position and travel measurement, control systems.

18. Pressure and force servo-mechanisms – the structure of the hydraulic circuit, block diagram. Measurement of controlled variables, control systems.

19. Velocity control loop - motion control of linear hydraulic actuators, rotational speed control of rotary hydraulic motors. Measurement of controlled variables, control systems.

20. DC controlled drives. Dynamic behaviour of the DC motor at voltage and magnetic flux changes. Static and dynamic properties of the actuators. Mechanical angular speed control without and with an inner, subordinate current loop. Position control - linear, time-optimal.

21. AC controlled drives. Basic types of AC motors, their principles and properties. Basic methods of speed and torque control of AC motors using frequency and supply voltage, resistance control, principle of vector control and direct torque control.

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