Means of Automatic Control

1. Industrial computer technology and its interconnection, function, design, properties, use. Systems for visualization and monitoring.

2. Programmable logic controller (PLC) and its inclusion in the field of industrial automation. Its comparison with PC. General description of the PLC. Description of optional modules.

3. Philosophy and methods for programming the PLC – the terms like process, scan cycle, stack. Data and operands.

4. Instruction set, instructions, macro-instructions, directives, subroutine. The principle of counter and timer functions.

5. Procedures for solving combinatorial and sequential tasks. Table instructions. SET and RES instructions.

6. Single-chip microcontrollers – structure, parallel ports, serial ports, bus communication, counters/timers, HCS08 or ARM Cortex-M microcontrollers, software and hardware tools for internal diagnostics of proper microcontroller operation, microcontroller application possibilities for process control.

7. Software for microcontrollers, creation, languages, compilers, instruction set, CISC and RISC processors, directives, the general procedure for creating programs. Creating a program in assembler.

8. The operation principle of real-time operating systems, RTOS system characteristics, its software components and data structures, planning strategies, "tick" of OS. Processes, task descriptor, means for transmitting information between processes and for synchronizing the running processes.

9. The states of user processes running under RTOS and their changes during the execution of the application: created, ready, running, blocked, completed, aborted. Description of RTOS services related to changes in the status of user processes, process services, system resources services.

10. System, classification of systems and variables, feedback, simple control loop, variables in the control loop, linearity, transfer functions in a closed control system, basic rules of block diagram algebra.

11. Discrete control system; the principle of operation, continuous variables, the sequences of discrete values, numerical variables, properties of the individual elements of a discrete control system, the principle of operation of the sampling and holding device.

12. Extension of a simple control loop – branched control systems, Smith predictor, loop with internal model.

13. Basic properties of L and Z transforms, definitions of direct transforms, transforms of n-th derivative and difference, the application of transforms for solving differential and difference equations.

14. Linear continuous-time dynamic systems (LCDS), their description, impulse and step response, transfer function, zeros and poles, order and relative order.

15. Stability in the sense of Lyapunov, the stability of LCDS, the necessary condition of stability, stable and unstable polynomials, algebraic and geometric criteria of stability and their use.

16. Continuous-time and discrete-time controllers, their parts and properties, PID controllers, physical realization, methods of tuning the controllers.

17. State-space description of LCDS, the ambiguity of state-space description, conversion of state-space model to transfer function and vice versa.

18. Electromagnetic compatibility (EMC classification, protection of electronic devices against interfering electromagnetic fields, sources of interfering signals, methods of transmitting the interfering signals).

19. The limits of the measuring devices, noise (methods of noise description, thermal noise, shot noise, flicker noise, quantization noise, noise analysis, SNR).

20. A/D and D/A converters (classification of signals, sampling, quantization, classification of converters, construction, parameters)

21. Means of touch measurement of the temperature, the types of sensors according to the physical principle (electrical resistance, thermoelectric), types of output signals from transducers (unified, data serial, data LAN), properties of measuring circuits.

22. Means of touchless measurement of the temperature, physical principle of function, types of sensors used, the design of devices (point, surface, camera-thermovision), types of output signals, emissivity issues, examples of use.

23. Means of measuring the flow of liquids, the principles and types of flowmeters and their parameters (accuracy, uncertainties in measurement, range, sensitivity, overload), types of output signals, design, examples of use.

24. Means of measuring the flow of gases and steam, principles, types and parameters of the flowmeters, flow correction according to the temperature and pressure of the measured medium, types of output signals, design, examples of use.

25. Means of reading identification data, the principles of barcodes, chip cards, RFID tags, data processing method and types of outputs, design, parameters and properties.