

INDUSTRIAL MEASUREMENT AND PROCESS CONTROL

general subject

(final exam topics, Automation specialization)

1. Functional units, system structure of PLCs, PLC architectures (generations), CPU parts, memories.
2. Classification, brief description, main parameters of PLC IO units. Structure, operation principles of digital input and output modules.
3. Differences between PLCs and computers. PLC program execution modes. Cycle time.
4. PLC selection viewpoints: hardware selection, problems of system performance, environmental conditions, PLC manufacturers' requirements.
5. Operational safety of PLCs: basic concepts, reliability, redundancy, failure coefficient, useful lifetime, tests, system engineering of safety PLCs.
6. PLC project structure specifications according IEC 61131-3 standard.
7. PLC programming languages and their peculiarities according IEC 61131-3 standard. Standard data types, operations, functions, function blocks.
8. Industrial control engineering networks. Ethernet network. PLC field bus systems.
9. Modbus communication specifications.
10. Profibus communication specifications.
11. Role of computer based measurement system. On-line and off-line systems in measurement and process control. Data transfer controlling in computerized measurement systems.
12. Functional diagram and elements of computer based measurement systems. Multiplexed and simultaneous acquisition systems.
13. Digitalization of analogue signals. Characterization, rules and laws of sampling and quantization.
14. Sample and hold circuitry of computer based measurement systems.
15. Analogue to digital conversion. Type of converters, summary and comparing of converters.
16. Functions and specification of multifunctional data acquisition equipment.
17. Application characteristic and functionality of analogue input of multifunctional data acquisition equipment.
18. Application characteristic and functionality of analogue output of multifunctional data acquisition equipment.
19. Process of data acquiring by computer based measurement system. Short time - high rate sampling and long time – low rate sampling.
20. Frequency analysis of sampled signals and effect of sampling parameters to the analysis results. Windowing and aliasing.
21. Describe the general features of sensors and their selection points of views.

22. Describe the methods and devices of temperature measurements.
23. Describe the measuring principle of the strain gauge.
24. Describe the devices of inductive displacement measurement (principle, types). Describe the devices of optical displacement measurement (types, operational principle).
25. Describe the devices of direct pressure measurement.
26. Describe the sensors of voltage- and current measurement.
27. Present diagnostic parameters and ranges of electrical mains fixed in the MSZ EN 50160 standard.
28. Describe the types of flow sensors.
29. Describe the types of humidity and gas sensors.
30. Describe the roles of actuators in control systems; define types of electromechanic and piezoelectric actuators.

The examination subject consists of the curriculums of the following subjects: TFBE1714 Programmable Logic Controllers (PLC), TFBE1712 Computer Controlled Measurement and Process Control, TFBE1716 Sensors and Actuators.

ACTUATORS OF INDUSTRIAL AUTOMATION specialized subject (final exam topics, Automation specialization)

1. Design of simple magnetic circuits, magnetic Ohm-law. Ferromagnetic materials, hysteresis curve.
2. Principle of operation and structure of single phase transformer, equivalent circuit, losses, conditions of parallel connection. Three phase transformers.
3. Mechanical basics of electric drives. Equations of geared drives, reduced equations and quantities. Stability of drives. Maximum acceleration drive.
4. Principle of operation and structure of commutator DC motors. Equivalent circuit and fundamental equations. Motors with external and series excitation. The armature reaction.
5. Rotary magnetic fields. Operation principle and structure of synchronous machines, torque and load angle. Equivalent circuit and circle diagram of synchronous machines.
6. Operation principle and structure of asynchronous machines. Slip, torque characteristic, equivalent circuit, circle diagram. Single phase asynchronous motors.
7. Operation and structure of the basic stepping motor constructions. Determination of stepping angle. Full and half step operation. Driving circuits.
8. Power semiconductor devices. Thyristor, Triac, Light Activated SCR, Gate Turn Off Thyristor, MCT...

9. AC-DC Converters, rectifiers. Half-wave controlled rectifier, phase control type. Controlled half-wave rectifier with R-L-E load. Full-wave controlled converter with center-tapped transformer.
10. AC-DC converters, rectifiers. 3-phase bridge rectifier.
11. AC Voltage Controllers. Cycloconverter. Illumination control circuit and its operation.
12. AC Voltage Controllers. Phase-control type. Phase half-wave control type. On-off control type. Three-phase ACVCs.
13. DC-DC converters. Step-down chopper (buck-converter) connected to resistive load and RLE load. Step-up chopper (boost-converter). Four quadrant choppers, circuit diagram and operation.
14. DC-AC converters, inverters. Half-bridge inverter. Bridge inverter. Three phase inverters and their conduction strategies.
15. Relays: function, parameters, classification, applications, structure of electromagnetic relays.
16. Fuses: function, parameters. Low-voltage fuses: classification, their structure, characteristics curves. General points of views of fuse selection.
17. Low-voltage circuit breakers: parameters, requirements, classification, their structure and operational principles.
18. Contactors: parameters, classification, function, structure, operational, arc quenching units, contacts, utilization categories, life span curves, selection.
19. Motor-protective devices, their selection.
20. Overvoltage protective devices: classification, their brief characterization.
21. Disconnectors: function, placement, parameters, structure, their drives, dielectric strength and operational current-load requirements, requirements implied fault current thermic and dynamic effects.

The examination subject consists of the curriculums of the following subjects: TFBE1711 Electrical Machines and Drives, TFBE1705 Power Electronics, TFBE1707 Electrical Switchgears.