Full time training
English – Mechatronics engineers – (MSc)
Mechatronics of Intelligent Robot Systems Specialization
E curriculum

State exam's questions
Sensors and Signal Analysis (actuator, sensor) + System and Control Theory

Subject code: BGK-MEI-2023-AMM-E-SSA+SCT
Compiled by:

Sensors and Signal Analysis

SSA 01 Classification of signals according to various points of view (deterministic, stochastic, real-value, complex-value, final duration, infinite duration, periodic, aperiodic, continous, quantized, analog, digital, parameters in time domain and in frequency domain)

SSA 02 Parameters of periodic signals in time domain and in amplitude domain (period, angular repetition frequency, rise time, fall time, stabilization time, delay time, minimal/maximal value, simple mean value, RMS value, absolute mean value, form factor, peak factor)

SSA 03 Classic form and measurement form of Fourier-series of periodic signals (expressions for Fourier synthesis and analysis, diagrams of Fourier spectrum, spectral lines, problems and solutions of calculation/measurement/technical application of classic and measurement-type forms of Fourier spectrum)

SSA 04 Complex form of Fourier spectrum of periodic signals (rotating complex vectors, meaning of positive/negative frequency, expressions for complex Fourier synthesis and analysis, diagrams of Fourier spectrum, symmetries in diagrams, calculation of complex Fourier spectrum, applying Laplace transformation, technical applications)

SSA 05 Power of periodic signals, energy of aperiodic signals (definitions, based on functions of time and based on Fourier spectrum, Parseval's theorems)

SSA 06 Complex form of Fourier spectrum of aperiodic signals (relation between periodic signals and finite duration aperiodic signals, lined spectrum vs. continous spectrum, expressions for complex Fourier synthesis and analysis of aperiodic signals, diagrams of Fourier spectrum, symmetries in diagrams, calculation, measurement, technical applications of continous Fourier spectrum)

SSA 07 Problems of ideal signal transporting units, linear systems (transfer functions, gain and phase shift requirements, real signal transporting units, group delay time characteristics, definition of linearity in signal transportation)

SSA 08 Possible reasons and types of sampling signals (low level information content, minimally disturbing processes, testing by breaking, multiplexing, digital storage, processing, transmitting of information, periodic, stochastic, adaptive sampling, 'mathematical'-'physical' sampling, basic question of sampling methods)

SSA 09 Mathematical' sampling (relation of signal to be sampled-sampling signal-sampled signal in time and in frequency domain, Shannons theorem, Nyquist-frequency, ideal signal reconstruction filters characteristics)

SSA 10 Irregular sampling (mirroring-shifting the spectrum of signal to be sampled, antialiasing filter, capabilities of sampling measurement technics)

SSA 11 Physical' sampling (condition of validity of sampling rules, sampling by sinusoid signal, signal reconstruction by real filter, methods of interpolation, distorsion effect of limited-time sampling, window functions)

SSA 12 Basics of electric transducers (block-diagram elements: sensor, electronic processing unit, output stage, standardised current range, living zero, supplying power by 4-wire, 3-wire, 2-wire connection to receiver unit)

SSA 13 Resistive type sensors (potentiometer-type, strain-gauge, sensing mechanical stress in 1 or in 2 dimensions, sensor electronic circuits: 1 bridge, 1 bridge, full bridge, neglecting cable resistance, compensation of temperature dependence)

SSA 14 Inductive, capacitive and optical type sensors (differential transformer, differential condensator, tachometer generator, magnetostrictive sensor, magnetic stripe position sensor, optical strain gauge, code-disc incremental/absolute sensor)

SSA 15 Electronic sensing mechanical quantities (speed, acceleration, rotation angle, rotation speed, force, pressure, inclination, torque)

SSA 16 Sensors for measuring temperature (dilatation in liquid, in solid material, in gases, bimetalic sensor, resistive temperature detector: RTD, thermistor, thermocouple: TC)

System and Control Theory

SCT 01 Definition of the concept of System and Control. Typical model classes: LTI, LPV, qLPV, generally nonlinear systems.

SCT 02 The general form of the solution of the equations of motion of the externally excited 1st order LTI systems: theresponse in the time domain as a convolution.

SCT 03 Stability, controllability, and observability of the LTI systems (similarity transformation, Jordan canonical form, Cayley-Hamilton Theorem);

SCT 04 Introduction of the frequency domain for LTI system models: the Laplace Transform and the transfer function in the frequency domain for multiple variable first order LTI systems: fractional matrix elements, poles and zeros.

SCT 05 The transfer function of the higher order single variable LTI systems in the frequency domain.

SCT 06 Bode diagram and Bode stability criterion for single variable LTI systems: limitations of this method.

SCT 07 Nyquist stability criterion.

SCT 08 The basics in PID control: the relaxation of the integrated error: stability prescription by the use of the Lyapunov eqaution.

SCT 09 The basics in PID control: guaranteeing stability by ploynomial-exponential products.

SCT 10 The basics in PID control: the method of Pole Placement for higher order single variable LTI systems considered as special 1st order multiple variable systems.