

**Title: Digital control****Lecturer:** Assoc. Prof. Dr. Sašo Blažič**Aim of the course:**

- to present the area of discrete control systems, i.e. the systems, given in a form suitable for digital control,
- to present complex methods of discrete systems analysis and design,
- to present some modern control algorithms to be implemented in digital control.

**Required (pre)knowledge:**

Basic system theory, control theory and signal processing

**Contents:**

Mathematical bases of discrete systems, sampled signals, z-transform, inverse z-transform, Parseval's theorem, relations among different forms of Fourier transform, relation between z- and s-planes, transfer function, discrete convolution.

States of discrete systems, state-space representation and transfer function, relation between system response and system eigen-values and eigen-vectors, system response as a function of the system matrix, fundamental matrix, methods for determination of a state transition matrix, the response of non-homogenous linear systems, equilibrium states of the systems.

Frequency response of discrete systems.

Discrete equivalent of continuous systems, discrete equivalent of continuous transfer functions, discrete equivalent of continuous systems given by state-space representations, the relation between continuous and discrete representations, transformation of continuous PID controllers into discrete ones.

Controllability and observability of discrete systems, canonical forms.

Stability of discrete systems. The notion of external and internal stability, graphical tests, stability criteria, stability of nonlinear systems, direct Lyapunov method.

State controller with a state observer. basic state controller, optimal state controller, state observer, Kalman filter, duality principle.

Minimum variance controller.

Robustness. Structured and unstructured uncertainties. Kharitonov theorem, robust control design in frequency domain.

**Selected references:**

Gene F. Franklin, J. David Powell, Michael L. Workman, Digital Control of Dynamic Systems, Third Edition, Addison-Wesley, 1997.

Karl Johan Astrom , Bjorn Wittenmark, Computer-Controlled Systems: Theory and Design Third Edition, Prentice Hall 1997.

Gurvinder Singh Virk, Digital Computer Control Systems, Macmillan, 1991.