Faculty of Technical and Human Sciences, Târgu-Mureş
Department of Electrical Engineering

Topics for examination
Assistant professor nr. 8

Control Engineering

1. Models for dynamic systems. Continuous and discrete time systems.
2. The second order dynamic system.
3. Basic notions of control engineering. Implementation of digital controllers.
4. PID controllers. Anti-windup modification. Manual-automatic, automatic-manual switching.
5. Basics of controller design. Negative Feedback. Design based on the reference model.
6. Steady state analysis of the control systems. Reference following. Disturbance attenuation.
7. Control of systems with dead time and large time constants. The effect of the dead time on control system, the Ziegler-Nichols method.
8. Self-tuning controllers.

Sampled data control systems

1. Controller design in state space (continuous, discrete). Pole placement using state feedback. Ackermann formula. Discrete implementation.
2. Realization of state feedback with state estimators. Load estimation. Integral control in state space.
3. Smith predictor. Discrete implementation.
4. Dead Beat controllers.
5. PID controller design with given phase margin in frequency domain. Extension of the phase margin based design for discrete time systems.
6. Linear control methods for nonlinear systems. Jacobi Linearization. Gain Scheduling.
7. Sliding control of nonlinear systems. Discrete implementation.
8. Adaptive control of nonlinear systems. Discrete implementation.

Robotics

1. The definition of robots. Characteristics of a robotic system. Sensors and actuators in robotics.
2. The geometry of robots. Description methods for the position and orientation. Basic transformations. The homogeneous transformation matrix.
3. The Denavit Hartenberg form. Direct geometry, inverse geometry.
4. Inverse and direct kinematics. The Jacobi matrix of the robots.
5. The dynamic model of robots. Euler Lagrange equation.
6. Trajectory generation for robots.
7. PD and PID control of robots.
8. Computed torque method.
9. Sliding mode control of robots.
10. Adaptive control of robots.
11. Hybrid force and position control of robots.

References

1. Lantos Béla, *Robot Control,* Akadémiai Kiadó, Budapest, 2002.
2. Frank L. Lewis, Darren M. Dawson, Chaouki T. Abdallah, *Robot Manipulator Control,* Marcel Dekker, Inc., NY, 2004.
3. Béla Lantos, János Somló, P. T. Cat, *Advanced Robot Control,* Akadémiai Kiadó, Budapest, 1997.
4. The ZODIAC, *Theory of Robot Control,* Springer-Verlag London Ltd, 1996.
5. W Khalil, E. Dombre, Modeling, *Identification and Control of Robots,* Taylor and Francis, NY, 2002.
6. Lantos Béla, *Design and Analysis of Control systems,* Akadémiai Kiadó, 2001.
7. William S Levine – *The control handbook,* CRC Press, 1996.
8. Bánhidi László, Oláh Miklós, *Automation for Engineers,* Tankönvvkiadó, 2001.

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