Title: Linear Electronics

Lecturer: Asst. Prof. Dr. Arpad Bűrmen

Aim of the course:

To attain basic knowledge of linear electronic system analysis and design.

Required (pre)knowledge:
Fundamentals of electrical engineering, fundamentals of nonlinear electronic devices, complex numbers, linear algebra, calculus.

Contents:
Modeling of linear electronic systems. Voltage, current, and power gain. Input and output admittance. Active/passive linear electronic systems and stability. Systematic approach to writing down circuit equations.

Modeling of nonlinear electronic components, Operating point of nonlinear electronic systems. Small-signal circuit model. Bipolar junction transistor orientations: common emitter, common collector, and common base. Unipolar transistor orientations: common source, common drain, and common gate. Darlington pairs, cascode amplifier, and differential amplifier.

Transfer function. Zeros and poles of a linear system. Bode diagram. Frequency-domain characteristics of linear circuits resulting from external capacitances. Nonlinear capacitances in linear electronics. Hybrid pi-model of bipolar and unipolar transistors. Miller transformation. Frequency-domain characteristic resulting from charge storage in transistors.

Linear feedback systems. Feedback in linear electronics. Frequency-domain characteristics of feedback systems. Stability and Nyquist criterion. Phase and gain margin.

Sine wave oscillators. Transient response and the poles of a linear system. Conditions for oscillation startup and stable oscillation. Barkhausen criterion for stable oscillation. Analysis of oscillator circuits.

Selected references:
Burns, Stanley G., Bond, Paul R., Principles of electronic circuit, PWS Publishing company, 1997.
Green, D.,C., Electronics, Logman group Limited, London, 1995.
Hambley, Allan,r., Electronics, Macmillan Publishing Company, 1994.
Tuma, T., Bűrmen, A., Circuit simulation with SPICE OPUS: Theory and Practice, Birkhäuser, Boston, 2009.