Title: Semiconductor Devices

Lecturer: Prof. Dr. Marko Topič

Aim of the Course:
To acquire fundamental and contemporary knowledge about electron devices, starting with semiconductor properties. To learn about the versatile importance of PN-junction(s) in semiconductor devices in the fields of electronics, optoelectronics and photonics. To transfer theoretical knowledge of semiconductors into operational principles of diodes, bipolar and unipolar transistors and other power electronic or optoelectronic devices under steady state or dynamic conditions.

Required (pre)knowledge:
Basic knowledge of electrical engineering and mathematics

Contents:

Semiconductors. Semiconductor materials and properties. Undoped and doped semiconductors.

PN junction and diodes. Analysis of electrostatic conditions, current-to-voltage characteristics of ideal and real PN-junction, regimes of operation, small-signal analysis, large-signal analysis, frequency dependence. Breakdown diodes and power diodes.

Bipolar transistors. Analysis of electrostatic conditions in PNP and NPN transistors, current-to-voltage characteristics of ideal and real bipolar transistors, regimes of operation, small-signal analysis, large-signal analysis, frequency dependence. Properties of different transistor orientations.

Unipolar transistors. FETs with PN junction and MOSFETs. Analysis of electrostatic conditions, current-to-voltage characteristics of ideal and real FETs, regimes of operation, small-signal analysis, large-signal analysis, frequency dependence. Properties of different transistor orientations.

Power electronic devices. Structures and principle of operation for PNPN diode, diac, tiristor, triac, IGBT.

Optoelectronic devices. Light emitting diodes, laser diodes, optocouplers, photodetectors, solar cells.

Selected references:
Neamen, D. A., Semiconductor Device Fundamentals, McGraw-Hill Education (ISBN: 0071116273) 2005.
Smole F. and M. Topič: Elementi polprevodniške elektronike, Založba FE in FRI, (ISBN: 961-243-020-9) 2008.
Kasap, S. O., Optoelectronics and Photonics; Principles and Practices, Prentice-Hall, (ISBN: 0-201-61087-6) 2001.