SYLLABUS

Name: ***Electronic devices and circuits (AESAu-A>SI3EDC24)***
Name in Polish:
Name in English: ***Electronic devices and circuits***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma.polsl.pl/rau3/course/view.php?id=80208

Short description:

This two-semester course offers a structured path from fundamental circuit theory to practical analog microelectronics. In semester 3 the students have only lectures which revisit Ohm/Kirchhoff laws, impedance and filters, then build through semiconductor physics to diodes, bipolarj junction transistors and field effect transistors. Credit for semester 3 rests on a final test.

Description:

(semester 3)
ECTS:3
Total workload: 65 hours (50 contact hours, 15 students' own work hours)
Forms of contact hours:
Lecture 45h
Other (e.g. test revision and discussion) 5h

Lectures (semester 3):
Basics of electrical engineering - review: Ohm, Kirchhoff laws, series and parallel connection of resistors, maximum Energy point, superposition, Thevenin/Norton circuits,
Signals: stationary signal decomposition, symbolic representation of alternating signals, impedance, R/L/C circuits and their impedance, RC/CR filters, transmittance, Bode's plots (amplitude and phase).
Semiconductors: resistivity across materials, atomic structure, Paulic principle, atomic configuration, energetic bands (valence, bandgap, conduction), current flow in materials, mobility of carriers, generation and recombination of carriers, donors and acceptors, temperature dependencies in microelectronics, Fermi distribution and Fermi level, fabrication of semiconductors (epitaxy, diffusion, ion implantation, creation and utilization of masks) .
Semiconductor diodes: basic structure of p-n junction, depletion region, forward and reverse polarization, types of diodes, I-V characteristics (linear and logarithmic), Schockley equation, thermal potential, approximation of I-V characteristics with examples of applications, dynamics of diode and its capacitance, maximum operating conditions, reverse current, temperature dependencies of I-V characteristics, Zener and avalanche diodes, varicaps, applications in rectifiers and stabilizers.
Bipolar transistors: basic internal structure, idea of operation, from p-n junction to n-p-n structure, npn transistor I-V characteristics, basic formulas, Early voltage, calculation of operating point (from full to simplified version), maximal operating conditions (including dynamical), temperature dependencies, thermal analysis of bipolar transistor with heatsink, small signals analysis (with hybrid model/parameters), transistors configurations (common collector, emitter and emitter, with examples and derivations) .
Field effect transistors: family of FETs (jFETs, MOSFETS, n vs p channel, depleted vs enhanced), principle of operation of different FETs, transfer I-V characteristics, output I-V characteristics, Ugs_off, Uds_pinchOff, ohmic vs saturation regions in output I-V characteristics, basic I-V formulas, FET as steered resistance, small-signals analysis of FETs, maximum operating conditions, temperature relations.

Bibliography:

Horowitz P., Hill W., The Art of Electronics. Cambridge University Press, 2015
Tietze U., Schenk Ch.: Electronic circuits. Springer-Verlag Berlin Heidelberg, 2008
Price T.E.: Analog Electronics. An integrated PSpice approach. Prentice Hall, 1997
Ciążyński W. E.: Elektronika analogowa w zadaniach, t.1, 2, 3. 4. Wydawnictwo Politechniki Śląskiej, Gliwice 2009-2010

Learning outcomes:

Describes the operating principles and key parameters of analogue electronic components—including resistors, capacitors, inductors, semiconductor diodes, BJTs, FETs, — relevant to basic engineering tasks.
Maps to: K1A_W8

Assessment methods and assessment criteria:

To obtain credits in semester 3, students mass pass (positive grade, i.e. 3.0) a test on topics explained on the lecture. Lecture attendence is optional (however highly recommended).

The syllabus is valid from academic year 2024/25 and its content cannot be changed during the semester.

Element of course groups in various terms:

Course group description	First term	Last term
Automation and electronics systems sem. 3 (AESAu-A>SI_3)	2024/2025-Z	

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	3	2024/2025-Z	