SYLLABUS

Name: ***Electronics and Measurements (InfAAu>SI2EaM19)***
Name in Polish:
Name in English: ***Electronics and Measurements***

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=80207
Short description:
This two-semester course offers a structured path from fundamental circuit theory to practical analog microelectronics. Lectures in semester 2 revisit Ohm/Kirchhoff laws, impedance and filters, then build through semiconductor physics to diodes, BJTs, FETs. Classes sharpen analytical skills with op-amp and transistor biasing, small-signal and frequency-response techniques, Credit for semester 2 rests on two in-class tests.
Description:
(semester 2)
ECTS: 3
Total workload: 75 hours (50 contact hours, 25 students' own work hours)
Forms of contact hours:
Lecture 30h
Classwork: 15h
Other (e.g. test revision and discussion) 5h

Lectures (semester 2):
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.

Classwork (semester 2)
Real and ideal operational amplifier - comparison. Basic configuration of the operational amplifier and their parameters. Analysis of linear circuits with ideal operational amplifiers. Frequency response of circuits with operational amplifiers. Response of a circuit to a given excitation. Operational amplifiers in nonlinear applications. Analysis of operation of a nonsinusoidal generator based on an operational amplifier.
Bipolar transistor – principle of operation, DC equivalent circuits. Basic methods of biasing of bipolar transistors. Method of biasing and stability of the quiescent point. DC analysis of circuits with bipolar transistors.
Small-signal analysis – idea, creation of the equivalent circuit diagram of a circuit, small-signal model of the bipolar transistor („h" and „y"). Determination of basic small-signal parameters of amplifiers (voltage gain, input and output resistance). Frequency response of transistor amplifiers.
Bibliography:

Horowitz P., Hill W.: Art of Electronics. Cambridge University Press, 2015
Ciążyński W. E.: Elektronika analogowa w zadaniach, t.1, 3. 4. Wydawnictwo Politechniki Śląskiej, Gliwice 2009-2010
Horowitz P., Hill W.: Art of Electronics. Cambridge University Press, 2015
Laboratory instructions available on the Remote Teaching Platform

Learning outcomes:
Explains fundamental circuit laws and semiconductor phenomena—including the operation of diodes, transistors and other analogue building blocks covered in the course.
Maps to: K1A_W05, K1AW07

Designs and analyses RC filters, transistor amplifiers and oscillators, using appropriate mathematical tools (e.g. small-signal models, Laplace transform) and physical reasoning.
Maps to: K1A_W05, K1A_U13

Seeks expert advice and specialised literature when confronted with problems beyond current competence, and applies the acquired knowledge to solve them.
Maps to: K1A_K02

Assessment methods and assessment criteria:

(semester 2)
To obtain credits, students mass pass (positive grade, i.e. 3.0) the two colloquia organized during the classes. Lecture attendence is optional (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
Informatics S1 semester 2 common subjects (InfAAu>SI2-19-WSP)	2020/2021-L	
Informatics sem. 2 (InfAAu>SI_2)	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	2020/2021-Z	