SYLLABUS

Name: ***Electronic devices and circuits (AESAu-A>SI4EDC24)***
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:

EGZ

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. Lectures in semester 4 revisit operational amplifiers and sinusoidal/non-sinusoidal oscillators. Classes sharpen analytical skills with op-amp and transistor biasing, small-signal and frequency-response techniques, while nine laboratory sessions translate theory into hands-on investigation of active devices, rectifiers and stabilisers. In semester 4 students must pass lab colloquia and reports, pass classes, a written theory test and a practical problem-solving exam. The final mark in semester 4 is the average of these four results

(To study in semester 4, a student should know topics explained in semester 3: Ohm/Kirchhoff laws, impedance and filters, semiconductor physics, diodes, BJTs, FETs)

Description:

(semester 4)
ECTS: 6
Total workload: 150 hours (90 contact hours, 60 students' own work hours)
Forms of contact hours:
Lecture 15h
Classwork: 30h
Laboratory: 30h
Other (e.g. test/exam revision and discussion) 15h

Lectures (semester 4):
Optoelectronic elements and devices: Lumens, Candelas and Luxes – definition, photoelectric effect, photoresistor with its dynamics and temperature dependencies, photodiodes – detectors, photovoltaic cells, sensitivity curves, dynamics, phototransistor – basics of operation, optoisolators – basics of operation and applications, light emitting diodes, charge coupled devices (CCDs) – principle of image creation and operation of CCDs, CMOS image sensors – comparison with CCDs.
Operational amplifiers: different types of op. amps, casing types, real vs ideal amplifier – comparison of parameters (resistances, gains, currents, voltages), simples op. amp. Explained with circuit, methods of improving internal structure, negative feedback loop principle of operation, basic structures with op. amps.: inverting, non-inverting, voltage follower, summator, frequency limitations of real operational amplifiers, slew rate, CMRR, circuit with hysteresis
Oscillators: conditions for sinusoidal oscillations, basics structures of sinusoidal oscillators with operational amplifiers and phase blocks, oscillators built on bipolar transistor, idea of relaxation oscillators, astable multivibrator, triangular wave generator

Classwork (semester 4)
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.

Laboratories (semester 4):
1. Semiconductor diodes
2. Bipolar transistor
3. Field effect transistors
4. Optoelectronic elements
5. Rectifiers
6. Stabilizers
7. Sinusoidal oscillators
8. Nonsinusoidal oscillators
9. Operational amplifiers

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, optoelectronic sensors and operational amplifiers—relevant to basic engineering tasks.
Maps to: K1A_W8

Applies Ohm’s and Kirchhoff’s laws, impedance concepts, small-signal models and Bode plots to analyse the time- and frequency-domain behaviour of RLC networks, amplifiers, filters and oscillators.
Maps to: K1A_W8; K1A_W9

Designs simple analogue subsystems—rectifiers, voltage stabilisers, transistor stages and op-amp-based filters or oscillators—so they meet stated performance and safety requirements.
Maps to: K1A_W9; K1A_W8

Sets up laboratory experiments on semiconductor devices and analogue circuits, selects suitable measuring instruments, and estimates combined uncertainties in accordance with metrology principles.
Maps to: K1A_W6

Interprets measurement results (e.g. I-V curves, gain-phase plots, sensor responsivity) to validate circuit models, refine designs and assess compliance with specification.
Maps to: K1A_W6; K1A_W9

Assessment methods and assessment criteria:

(semester 4)
To obtain credits, student receive positive grades from:
a) laboratories – i.e. pass colloquium, attend to all exercises, return all required reports,
b) classes (2-4 tests, as required by a teacher)
b) theoretical exam (pass the test consisting of 20 question)
c) practical exam (solve the minimum required number of tasks, as according to the requirements of a teacher)
The final grade is calculated as an average of the four grades listed above.

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
missing group description in English (AESAu-A>SI_4)	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)	6	2024/2025-Z	