IE1202 Analog Electronics 7.5 credits

Analog elektronik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for IE1202 valid from Autumn 2009

Grading scale

A, B, C, D, E, FX, F

Education cycle

First cycle

Main field of study

Technology

Specific prerequisites

Completed upper secondary education including documented proficiency in Swedish corresponding to Swedish B and English corresponding to English A. For students who received/will receive their final school grades after 31 December 2009, there is an additional entry requirement for mathematics as follows: documented proficiency in mathematics corresponding to Mathematics A. And the specific requirements of mathematics, physics and chemistry corresponding to Mathematics D, Physics B and Chemistry A.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The student will after the course understand analog electronic circuits and how they can be designed with components such as operational amplifiers and transistors. The student will be able to individually dimension, simulate, build and test a low frequency analog electronic circuit from a given problem or specification.

For a passing grade the student shall be able to:

- define and calculate gain, input and output impedances for amplifiers based on operational amplifiers and transistors.
- choose suitable amplifier configuration and design those to solve different kind of amplification problems.
- determine transfer funcion for frequency dependent amplifier circuits, draw bode plots (magnitude and phase) and calculate frequency bandwidth.
- describe the function and explain the characteristic data for operational amplifiers, diodes and transistors.
- define the concepts of feedback in terms of basic gain, (open loop gain), closed loop gain, loop gain, feedback factor and stability margins.
- explain why feedback amplifiers can be unstable and explain the basic function of oscillator circuits.
- design simple RC-oscillators with operational amplifiers.
- describe current-voltage characteristics and large signal models for diodes and the bipolar and MOS type of transistors.
- calculate the small signal parameters for transistors and use small signal models to calculate gain, input- and output .resistance for basic transistor amplifiers (CE- and CC-stages and differential amplifiers) of bipolar and MOS type.
- verify designs with SPICE simulation program.
- build a prototype and by measurements evaluate the performance of analog circuits.
- write a documentation of the designed circuits.

For a higher grade the student shall be able to:

- value for a given application which component that is most suitable by assessing the information from datasheets on operational amplifiers, diodes and transistors.
- analyse effects of offset voltage and input bias currents in operational amplifier circuits and determine if compensation is needed.
- calculate stability margins for feedback amplifiers and dimension compensation networks for potentially unstable amplifiers.
- value how the changing of component values will change the amplifiers performance.

- create models for analog amplifiers and out of that derive gain, input and output impedance.
- calculate the way the high frequency model of a transistor influence an amplifier circuit.
- design multiple transistor amplifiers with transistors.

Course contents

- System level properties of analog circuits. Gain, input impedance, output impedance and bandwidth.
- Operational amplifiers and the characteristics of operational amplifiers. Amplifier built with operational amplifiers. Differential amplifiers, common mode, differential mode, CMRR.
- RC-filters and bode plots. Frequency response of amplifiers. The principle of feedback. Stability problems in feedback amplifiers. Oscillators.
- Semiconductor components, diodes and transistors. Diode circuits. Transistor amplifiers of the type CE/CS, CC/CD and differential amplifiers. Circuits for biasing.
- The transistor as a switch.
- Use of circuit simulators (PSpice) and measurements on amplifiers.

Course literature

Litteratur: Analog elektronik, Molin
Upplaga: 2 Förlag: Studentlitteratur År: 2009
ISBN: 978-91-44-05367-7

Tidigare:
Microelectronic Circuits, Sedra/Smith
Upplaga: 5 Förlag: Oxford University Press År: 2004
ISBN: 0-19-514252-7

Examination

- LAB1 - Laboratory work, 2.5 credits, grading scale: A, B, C, D, E, FX, F
- TEN1 - Oral examination, 5.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

LAB1 - Lab- och design exercises grade, 2,5 credits, grade A-F

TEN1 - Written exam, 5,0 credits, grade A-F

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.