Module description
of
Electrical and Electronic Engineering S3

Exchange program Fall 2021 – 2022

Fontys Hogeschool Engineering

Module : Analogue Design 3

Module code : EXEEAAD3

Size : 4 EC (112 hours)

Content of the module

Although this module is a continuation of the modules Analog Design 1 and Analog Design 2 that are part of previous study years, the theory of the first two modules will be studied in depth in this module once more, but there will be also new theory introduced.

The subjects of the module include:

- **The Operational Amplifier:**
  General introduction into Op-amps. Input modes and parameters are discussed. An introduction into negative feedback. Negative feedback and the influence of negative feedback on the impedance of the Op-Amp. Bias currents and offset voltage compensation. Open and closed loop response. Comparators and summing amplifiers. Integrators and differentiators
- **Active Filters:**
  Basic filter responses, filter response characteristics, Active low/high/band pass/stop filters. Oscillators and Voltage regulators

Prerequisite requirement

You should be familiar with most of the subjects mentioned below to be successful:

- Apply Ohm's law and Kirchhoff's laws to calculate a series, parallel and mixed network and depending, voltages, currents or resistance values.
- Recognizing and naming special situations such as: open voltage, short circuit, resistance parallel to voltage source, resistance in series with current source and the like.
- Phasor diagram of inductors, capacitors and series/parallel circuits.
- The concept of resonance and the resonance frequency of a serial or parallel circuit.
- The quality factor and determine the size of Q in a non-ideal capacitor / inductor of a relatively simple frequency-dependent circuit
- Identify the specific characteristics of a transistor. Identify a Class A voltage amplifier design with a transistor on the basis of specifications (DC and AC behaviour) and draw the correct symbols of a transistor (NPN and PNP) and indicate the connections (base, collector, emitter)
- Bode plots of a first and second order filter including the characteristic points (-3 dB points)
- Set up a passive RC and RCL circuit and construct with the measured results a Bode plot
- Explain the effect of a resistive load on the voltage gain and be able to calculate this effect in a numerical value (attenuation)
- Explain and apply the advantages and disadvantages of an emitter and source follower
- Calculate, of an emitter and source follower circuit; the voltage gain, the input resistance and output resistance.
- Calculate, explain and demonstrate the mutual interaction of multiple stage transistor circuits

Module : Embedded Systems
Module code : EXEEAES
Size : 5 EC (140 hours)

Main objectives/goals

After completing this course, the student will be able to:

- Design/implement/test a simple embedded system based on customers' specifications using a structured approach.
- Explain interrupts and write interrupts service routine (ISR) to handle them.
- Interface and program the microprocessor/microcontroller to interact with peripheral devices such as timers, serial interface, and analogue to digital converters.
- Understand and explain how complex embedded software is designed using systems-level programming concepts such as modular design and layering .

Content of the module

- Introduction to Embedded C language.
- Microcomputer Systems: general architecture of a microcomputer system, overall operation and the fetch-execute cycle, comparison of CICS and RISC based systems.
- Input/output circuits and operation: I/O interfaces, conditional and unconditional I/O, programming examples.
- Peripheral devices: architecture, operation and interfacing of peripheral devices such as Timers, Output Compare, UART and ADC.
- Interrupt handling: interrupts handling versus polling.
- Basic techniques for embedded system design: requirements, structural description and behavioural descriptions.
- System-level programming concepts

Prerequisite requirement

- Combinational and sequential digital systems (Digital Design)
- Programming in C (Software Design)
- Basics of computer architecture

Module : Control Theory 1
Module code : EXEEACT1
Size : 5 EC (140 hours)

Main objectives/goals

The goal of the Control Theory module is to introduce the basic concepts of control systems with a focus on electrical systems. This includes open and closed loop control systems, which we will analyze in the time domain and introduce the Laplace Transform for analysis in the s-domain. The module offers theory, but also practical applications.
In the practicum focus will be on the application of Matlab/Simulink tool for analysis and simulation of control systems.

After studying the CT1 module you are able to:

- State the system properties (linearity, continuous/discrete, analogue, time invariant and SISO) and prove these properties for a given system.
- Determine the transfer function in the Laplace domain for a differential equation up to the second order.
- Transform a given input signal from the time domain to the Laplace domain and a given output signal from the Laplace domain to the time domain based on the table with standard transformations and rules.
- Calculate the unit step, pulse response and the frequency response for a given system in both Laplace and time domain.
- Construct the pole-zero plot from a transfer function given in the Laplace domain and construct the transfer function from a given pole-zero plot.
- Apply the basic building blocks in an open loop system
- Apply the basic building blocks in a closed loop system.
- Analyze stability of a closed loop systems in omega and *s*- domain.
- Explain the following characteristics of a closed loop system: static error, time response (rise time), overshoot, and damping.
- Apply root locus up to second order systems.
- Analyze, evaluate and design PID control systems.

Content of the module

A control system is a system, that manages, commands, directs or regulates the behavior of other device(s) or system(s) to achieve desire results. In this module, we will provide an introduction to what exactly a control system is, analyze what it does and how to design one. Typically, control systems are described by differential equations. To analyze such systems, we introduce mathematical techniques in the time domain, learn how to apply the Laplace transformation to transform the system description to the *s*- and ω-domain and compute the system properties. The main objective is to learn the student how to analyze and design a control system.

Prerequisite requirement

To participate in this course, you need to have experience in solving linear differential equations, know how to solve problems with complex numbers.

Module : Fields & Energy Conversion
Module code : EXEEAFEC
Size : 5 EC (140 hours)

Main objectives/goals

- Learn about (static) electric and magnetic fields, also term like field strength, flux, potential energy, the laws of Coulomb Gauss, Ampère, Maxwell, Faraday, Lenz
- Learn about terms of field lines, isolator, conductors, dielectric, electron volt, Hall-effect, ferromagnetism, hysteresis, Lorentz force, torque, magnetic induction
- To calculate the field strength, potential, force, torque, energy in different situations
- To practice the theory to capacitors, coils and a magnetic motor/generator
- To apply the field theory in the experiments of FEC
- Learn about the different kind of energy and conversion of energy, also terms like energy, power, efficiency, force, energy sources
- Learn about modelling a mechanical drive system, with a motor characteristic, load characteristic, gears, efficiency as well for linear as rotational systems
- Learn about the principle of force generation out of electric energy
- Apply the theory to a single conductor motor with the force/speed characteristic
- Learn about the direct current (DC) motor, with the torque rotational speed characteristic
- Make calculations for a drive system with a DC-motor
- To apply the energy conversion theory in the experiments of FEC

Content of the module

The theory of Electric and Magnetic Fields. Electromagnetism, Electromagnetic waves, Energy Conversion and Drive Systems that the students have learned, is put into practise with exercises, practical assignments and projects.

Prerequisite requirement

Analogue Electronics including physics about atoms e.g. Bohr model and electrical properties of materials. Mathematics including applying mathematical formulas, vectors, differential equations, integrals, and complex numbers.

Module : eXPo projects

Module code : EXEEAPROJ4 and EXEEAPROJ5

(each quarter a project)

Size : 4 EC and 3 EC (112 and 84 hours)

EXPO Learning Goals

With the project educational model in Engineering, students are given the opportunity to apply theory in practice. One educational module in Fontys engineering that provides the opportunity for students is EXPO: Engineering eXPerience Organisation). In this module, students are working on assignments that originate from the field of engineering. Many of these assignments originate directly from industry.

It is important that the student gets a sufficiently broad education. Not only that the student acquires competence in the roles engineers take but also that the student gains experience and develops competences in multiple Engineering areas.

Objectives

After participation in EXPO projects and depending on the roles, students can

- make a structured product design,
- are experienced in team work in a company assignment

Understanding in:

- (Multidisciplinary) group work • Designing products for a customer • The documents and test plans needed for each stage of the product development process • Design within the students educational domain (electrical, mechatronic or mechanical engineering)

And the student can:

- Apply methodological design techniques in project work
- Specify product requirements (and write the System Requirements Document (SRD) based on the research document (RD)
- Make a high-level system design that suffices the requirements (write the System Design Document (SDD))
- Make low level system designs of all modules that make up the high-level system design. (and write the Module Design Document (MDD))
- Set up a test plan to test the system suffices requirements (write the test document (TD))
- Build the system and test it according to test plans (TD),
- Reason on the test results and draw appropriate conclusions (TD).

Module : System Engineering

Module code : EXEEASEN3

Size : 2 EC (56 hours)

Main objectives/goals

After realising this module, the student is able to:

- Student is able to define the context and scope of a relevant engineering problem in a feasible way
- Formulate a SMART main research question and break it down in supporting sub questions
- Formulate a functional hypothesis to systematically approach the literature research
- Critically and systematically evaluate the literature on relevance and applicability in their research, and use it to underpin the hypothesis.
- Pitch the achieved result in the chosen scope by means of a convincing poster presentation
- Review a Research Proposal Document according a given template
- Referencing using IEEE format

These objectives will be examined in the following way. The student will:

- Write a Research Proposal Document according a given template (frame a specific research question and related sub questions); formulate a research hypothesis based on these specific questions).
- Review a Research proposal in a proper way according given template.
- Select, analyse, discuss and summarize a scientific paper on how and what to apply in the research based on the Journal Club
- Develop and present a Research Document (RD) according given guidelines (answer the research questions as much as possible based on theoretical research; analyse and interpret data by relating results to the original hypothesis/test plan); ability to express the hypothesis, background, methods, results, and significance of an experiment in correct, articulate English. In this course, the format of the RD is a scientific poster in combination with a pitch.

Prerequisite requirements

None

Module : Communication 3

Module code : EXEEACOM3

Size : 2 EC (56 hours)

Main objectives/goals

In this course the central theme is ethics, which will be addressed by the following content:

- Responsibility of the engineer
- Moral issues in emerging technologies
- Ethical thinking frames/perspectives
- Ethical cycle (from problem to solution)

The learning goals are:

- Provide the student with sensitivity to moral issues, especially within their responsibility of an engineer.
- The student is able to analyse / identify a problem
- The student is able to think solution-oriented and to take moral points of view and to argue.
- The student is able to respect and evaluate other moral beliefs.
- The student is able to determine whether an action can be qualified as good or fault.

Prerequisite requirements

None