Semester 3:

Analogue Electronics 4 (AEN4)

Content

- Subjects
- Inductors and capacitors in the time domain
- Average value
- Step-down (Buck) converter
- Continuous and discontinuous conduction mode
- Conduction and switching losses
- Ripple voltage and ripple currents
- Effective (rms) values
- Step-up (Boost) converter
- Buck-Boost converter
- Flyback converter
- Transformers
- Isolated converters
- Capita selecta

Specific learning goals

Theory: This course focuses on switched mode power supplies.

Embedded Systems (ES)

Course Contents

Topics:
- Introduction to Embedded C language.
- Microcomputer Systems: general architecture of a microcomputer system, overall operation and the fetch-execute cycle, comparison of CIS 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 behavioral descriptions.
- System-level programming concepts

Learning Objectives
- 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.
Control Theory 1 (CT1)

Main objectives/goals
To get familiar with analysis of open loop and closed loop continuous time control systems, using Laplace transform techniques, pole zero plots (or root locus plots for closed loop systems), and frequency response techniques (Bode plots).
In the practicum focus will be on the application of Matlab/Simulink tool for analysis and simulation of control systems.

Content of the module
- Introduction to control systems, modelling in the s-domain including the Laplace transfer (transfer function, pole/zero plot) and its mathematical backgrounds
- Time response of 1st, 2nd or higher order systems in relation to pole/zero plots
- Stability
- Steady state errors (and reduced block diagrams) of closed loop systems
- Root locus techniques: how to sketch a root locus, and how to use it for control systems design, plus implementation and realization of PID controllers or lag-lead compensators
- Frequency response techniques (sketching Bode plots, Nyquist diagrams, gain/phase margin)

Fields, Energy and Conversion (FEC)
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 driving 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 driving system with a DC-motor
- To apply the energy conversion theory in the experiments of FEC

System Engineering 3 (SEN3)

Course Objectives (goals):

1. Ability to express the hypothesis, background, methods, results, and significance of a literature research on one of the following fields:

In SEN3:
a) Learn and explore contemporary/trending concepts in his/her research area
b) Apply critical thinking and problem solving skills in an authentic research experience;

In your projects is also possible:

c. Learn lab/field techniques (e.g. instrumentation and measurement)
d. Integrate Electrical & Electronic (E&E) engineering theory and practice

2. Retrieve information from scientific papers, Journals, books and internet
3. Answer the questions as much as possible based on theoretical research
4. Relate results to the bigger picture in the research area
5. Analyse and interpret data by relating results to the original hypothesis/test plan
6. Present technical work effectively in a report

**eXPo projects**
Semester: S3 (project 4 and 5)

**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).

Curriculum Supporting Activity 1 (CSA1)
Helping the Fontys E&E community to grow in quality and understanding

Content
- CSA activities: you will work on a self-selected or recruited activity which helps the Fontys E&E community as a whole. Possible activities for CSA are:
  - Technical teaching assistance
  - Student-assistant at practical work
  - Student-assistant at lectures (theoretical assistance)
  - Coaching of first year projects
  - Buddy for first year students
  - Small educative projects
  - Tasks in practical assignment developments in courses
  - Tasks on PR activities (Open days, developing products to be shown at the open days, other assistance)

Learning goals
- Students learn to share information with fellow students or show they are able to use their knowledge and practical experience in developing new items for the curriculum of electronics.
Semester 4:

Analogue Electronics 3 (AEL3)

This course focusses on op-amps and active filtering

1. Content of the module

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

Digital Design 3 (DD3)

1. Main objectives/goals

The student(s) can – after doing this course - describe, realize and test in VHDL a complex digital system, simulate and synthesize using FPGA

2. Content of the module

- Introduction to VHDL
- Modelling of digital systems on functional, RTL and structural level.
- Design and simulation of combinational circuits using VHDL
- Design and simulation of sequential circuits using VHDL
- Introduction FPGA, FPGA prototyping board and design process

Embedded Connectivity (EMBC)

Course Description

In this Embedded Connectivity course, the student will get a better understanding and will be introduced to new techniques being used for the design of complex embedded applications and more specifically microcontrollers based applications. The communication between embedded systems and external peripherals and between embedded systems themselves will be explored. The student will get an overview of the different communication technologies being used in embedded systems and he will learn how to choose the suitable solution by understanding the advantages and disadvantages of these technologies.

Subjects

- Wired serial communication: RS232, UART, I2C, and SPI.
- Wireless serial communication: Bluetooth, ZigBee, and 433MHz low-power device.
- The OSI model, the TCP/IP stack, routing and web technologies.
- The use of SysML diagrams for describing complex embedded software.
- The use of third parties software libraries, such as TCP/IP or USB.
- Multitasking in embedded systems.
• Limited resources such as memory, clock frequency, processing power and low power consumption.

Objectives
After following the course the student can

• Describe wired and wireless serial communication that are used in embedded systems and justify his choice of the right one for the specific application..
• Describe ICT network concepts, including the OSI-model and the TCP/IP-stack and calculate the routing with IPv4-addresses.
• Describe the principle of client/server communication..
• Design and implement structured and complex embedded systems with the use of the available software libraries.
• Make the right decisions regarding the to be developed architecture and its behaviour based on the given specifications.
• Illustrate his design effectively to the other students and professionals by the use of SysML diagrams.

Signal Processing 1 (SP1)
Basics of digital signal processing (DSP) and digital filter design

Part SP1T1
Objectives
The student will understand / have knowledge of:

● Classification of systems
● Discrete signals
● The z-transform
● Fourier series and the Fourier transform

Part SP1T2 / SP1P2
Objectives
1. Offering a solid base of knowledge in the area of digital signal processing (DSP). In this part, the emphasis is on a practical approach to DSP. This approach will be supported, however, by a more theoretical framework, which is essential for completeness and subsequent modules.
2. After this module, the student will be able to:
3. Sample a time continuous signal according to specifications
4. Analyze digital filters and design an IIR filter according up to specifications
Telecommunications (TEL)
Main objectives/goals
The student:

- acquires skills in the application of signal description in the frequency range using Fourier and gain insight into the interpretation of signal in time and frequency domain representations.
- acquires knowledge of signal processing operations that are necessary to make it suitable for telecommunications media information signals, such as cables and radio links. In particular, it concerns knowledge of amplitude modulation (AM), frequency modulation (FM), phase modulation (PM), pulse code modulation (PCM) line modulation methods (PSK, ASK, FSK, QAM, Manchester code, AMI, HDB3 and their relatives).
- gains insight into the problems that arise when designing radio receivers, such as selectivity and the occurrence of image frequencies in a super heterodyne receiver.
- gains insight into the requirements to be imposed on a PCM system to obtain an acceptable compromise between signal quality and system complexity. (practical filters, sample theorem, bit rate and quantization noise)
- gets acquainted with specific problems that occur in the transmission of pulsed signals such as PCM signals on cable and radio communications (inter-symbol interference and Bit Error Rate).

Content of the module
1. Some basic understanding of signal theory, representation of signals in time- and frequency, Fourier series, spectra and signal power.
2. Fundamental knowledge about basic limitations imposed on communication systems: analog and digital communications; modulation schemes, AM, FM, PM, ASK, PSK, FSK, linecoding, NRZ, biphase, AMI, HDB3, sampling, Shannon's theorem, bitrate, analog to digital conversion, quantization noise, distortion, intersymbol interference, bit error rate.
3. Knowledge about communication systems: analog vs. digital systems; direct detection vs. heterodyne systems, multiplexing schemes (FDM, TDM, PCM).

EXPO projects
Semester S4 (project 6 and 7)
EXPO Learning Goals
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Objectives
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Understanding in:
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- Build the system and test it according to test plans (TD),
- Reason on the test results and draw appropriate conclusions (TD).

Curriculum Supporting Activity 2 (CSA2)
Helping the Fontys E&E community to grow in quality and understanding

Content
- CSA activities: you will work on a self-selected or recruited activity which helps the Fontys E&E community as a whole. Possible activities for CSA are:
  - Technical teaching assistance
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Learning goals
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