Module description of Electrical and Electronic Engineering S4

Exchange program Spring 2021 – 2022

Fontys Hogeschool Engineering

Module : Telecommunications

Module code : TEL

Size : 3 EC (84 hours)

Main objectives/goals

After studying the TEL1 module the students are able to:

- Explain the functions of the three main parts of an electronic communication system
- Define the electromagnetic spectrum and explain why the nature of electronic communication makes it necessary to regulate the electromagnetic spectrum
- Calculate bandwidth by using Fourier analysis
- Calculate the modulation index and percentage of modulation of an AM signal, given the amplitudes of the carrier and modulating signals
- Define over-modulation and explain how to alleviate its effects
- Explain how the power in an AM signal is distributed between the carrier and the sideband, and then compute the carrier and sideband powers, given the percentage of modulation
- Compare time-domain, frequency-domain, and phasor representations of an AM signal
- Explain the relationship of the basic equation for an AM signal to the production of amplitude modulation, mixing, and frequency conversion by a diode or other nonlinear frequency component or circuit
- Calculate the modulation index given the maximum deviation and the maximum modulating frequency and use the modulation index and Bessel coefficients to determine the number of significant sidebands in an FM signal
- Calculate the bandwidth of an FM signal by using two methods and explain the difference between the two
- Explain how quantizing error occurs, describe the techniques used to minimize it, and calculate the minimum sampling rate given the upper frequency limit of the analogue signal to be converted
- Explain why pulse-code modulation has superseded pulse-amplitude modulation (PAM), pulse-width modulation (PWM), and pulse-position modulation (PPM)
- Draw and fully label a block diagram of a digital signal-processing (DSP) circuit
- Explain the biasing and operation of class A, AB, and C power amplifiers using transistors.
- Discuss the operation and benefits of class D, E, and F switching amplifiers, and explain why they are more efficient
- Explain the basic design of L, π, and T-type LC circuits, and discuss how they are used for impedance matching
- Identify the function of each component of a superheterodyne receiver
- Express the relationship between the IF, local oscillator, and signal frequencies mathematically and calculate any one of them, given the other two

- Define pulse-code modulation, draw the diagram of a typical PCM multiplexer, and state the primary benefit of PCM over other forms of pulse modulation
- Describe the generation of FSK, PSK, QAM, and OFDM
- Explain the need for and types of communication protocols
- Explain the operation and benefits of spread spectrum systems
- Identify the features, benefits, applications, and operation of the wireless technologies Wi-Fi, Bluetooth, ZigBee, WiMAX, and ultra-wideband (UWB)
- Explain the operation and applications of the wireless technologies RFID, NFC, and IR
- Explain White Space radio
- Define the Internet of Things (IoT) and machine-to-machine (M2M) wireless

Content of the module

In this module the student will be familiar with all aspects of telecommunications. In this module the students learn the fundamental aspects of telecommunications; radio receivers, radio transmitters, time domain calculations, frequency domain calculations, radio laws, HAM radio, Digital communications and wireless standards.

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, familiar with applying the Fourier transform, understanding the Time- and Frequency domain.

Remark

The module heavily relies on **McGraw-Hill Connect®**[1] and on **McGraw-Hill LearnSmart®**[2].
The students must (mandatory) therefore buy the book, with the unique ISBN code "9781526820280" (https://www.studystore.nl/zoeken?search=9781526820280) in order to get access to Connect and LearnSmart. During this module the students get familiar with the systems from McGraw-Hill.

Module : Digital Design 3
Module code : DD3
Size : 5 EC (140 hours)

Content of the module

After studying this module, the student should have the basics of digital design, such as

- understanding the architecture of registers (accumulator, shift registers, …)
- understanding the Mealy architecture
- understand the differences between Moore and Mealy machines
- understand the syntax of ASM diagrams, and is able to apply these diagrams when designing state machines
- understand the data path controller architecture

Similar, the student should also have the basics of embedded systems, such as

- 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

Basic knowledge of digital design and VHDL are required.

Module : Embedded Connectivity
Module code : EMBC
Size : 5 EC (140 hours)

Main objectives/goals

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.

Content of the module

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 the these technologies.

Subjects include wired and wireless serial communication, 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 and limited resources such as memory, clock frequency, processing power and low power consumption.

Prerequisite requirement

The student should have the basics of embedded systems, such as

- 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

Module : Analogue Electronics 4 (AEN4)
Code : AEN4
Size : 3 EC (84 hours)

Main objectives/goals

The student gets familiar with switched mode power supplies.

Content of the module

- 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

Prerequisite requirement

The student should have the basic knowledge on circuit theory and electronics.

Module : Signal Processing 1
Module code : SP1
Size : 4 EC (112 hours)

Main objectives/goals

The student will understand / have knowledge of:

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

And offers a solid base of knowledge in the area of digital signal processing (DSP), where 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.

- Sample a time continuous signal according to specifications
- Analyze digital filters and design an IIR filter according tot specifications

Content of the module

- Sampling, quantization
- Time-domain analysis
- Frequency-domain analysis (Fourier)
- The z-transform
- Recursive filter design
- Nonrecursive filter design

Prerequisite requirement

A strong basis in mathematics, including complex numbers, goniometry and solving equations.

Module : eXPo projects

Module code : Proj 6 and 7 (each term a project)

Size : 3 EC per project (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 : Electromagnetic Compatibility

Module code : EMC

Size : 4 EC (112 hours)

Content of the module

The EMC course covers the basics during the design process needed to bring a circuit or an electrical system to get that/it satisfactory. The phenomena covered by the term Electromagnetic Compatibility takes place both on a chip on a board like this and continues to systems and installations. The requirements set out by the users or customers of the products, play a very important role in the harmonization of these requirements written down in the guidelines of the EEC.

Prerequisite requirements

- Knowledge of static electric and magnetic fields
- Skilled in determining transfer functions of R, L and C
- Combinations of paired coils can calculate
- Fourier series of signals to apply
- Calculate with complex numbers
- Operate an analogue simulation package i.e. SPICE

Module : Business Economics
Module code : BE / HE4
Size : 4 EC (112 hours)

Learning goals / content of the module

The student is able to:

- Identify the purpose of a business and discuss the ways in which a business may be organized and managed
- Discuss the issues to be considered when setting the financial aims and objectives of a business.
- Explain the role of management accounting
- Define and distinguish between relevant costa, outlay costs and opportunity costs
- Identify and quantify the costs that are relevant to a particular decision.
- Distinguish between fixed cost and variable cost and use this to explain the relationship between cost, volume and profit.
- Prepare a break-even chart and deduce the break-even point for some activity.
- Discuss the weaknesses of break-even analysis.
- Deduce the Full (absorption) cost of a cost unit in a single-product environment
- Deduce the Full (absorption) cost of a cost unit in a multi-product environment
- Discuss the problems of deducing full (absorption) cost in practice
- Discuss the principles and practicalities of activity-based costing.
- Explain how new developments such as total life-cycle costing and target costing can be used to manage product costs.
- Define a budget and show how budgets, strategic objectives and strategic plans are related
- Explain the budgeting process and the interlinking of the various budgets within the business
- Undertake variance analysis and discuss possible reasons for the variances calculated
- Discuss the role and limitations of budgets for performance evaluation and control.
- Explain the nature and importance of investment decision making
- Make a decision analysis and calculate the net present value.
- Deal with risk in a best and worst case decision calculation.
- Explain how management accounting information can help a business gain a better understanding of its competitors and customers.
- Explain how the balanced scorecard can help monitor and measure progress towards the achievement of strategic objectives.
- Discuss the potential advantages and disadvantages for a business of adopting a divisional structure.
- Identify the major methods of measuring the performance of operating divisions and divisional managers and assess their usefulness
- Describe the problems of determining transfer prices between divisions and outline the methods used in practice.
- Identify the main elements of working capital.
- Discuss the purpose of working capital and the nature of the working capital cycle
- Explain the importance of establishing policies for the control of working capital.

Prerequisite requirement

None

Module : Customer Oriented Innovation

Module code : HE20

Size : 4 EC (112 hours)

Main objectives/goals

- Get to know the many different ways of product innovation
- Find out the pro's and con's of customer involvement in the innovation process
- Meet and explore companies who are working in this field of product development
- Get familiar with product innovation and the relation within the development process and the steering of such a processes
- Get experience in translating theoretical information into a product
- Get experience in setting up and carrying out a research project
- Get experience in writing an article
- Get experience in making conclusions available for a wider public by producing a Youtube video based on the research results

Content of the module

You do want to know more about innovation in industry. One way is to read about the many different ways of developing new products, creating ideas and exploring how customers are involved in this process. A different method is to do research by going into the field and find out what customer involvement means for innovation. In this module you are going to find the pro's and con's of the different ways of product innovation by doing research in the industry in a small group. One of the focus points will be the involvement of customers in this innovation process. By carrying out this research you will learn to have a critical view on product innovation; all this by studying theory, articles, papers and hands on research work in industry.

Prerequisite requirements

None