Study Guide Technology Semester 3 Course-Based

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1. Information about BA ICT & Technology OE3

1.1. Entry requirements

The target group of this semester consists of second-year students who have chosen the technology profile. Students from both EU2 DB and EU2 CB can enter this educational unit. For all students, we require the following competence profile:

Semester 2T	To advise	Analyse	To design	Realise	Manage & Control
User interaction					
Organisational processes					
Infrastructure					
Software			1	1	
Hardware interfacing	1	1	1	1	1

1.2. Learning Outcomes

A Cyber Physical System (CPS) is a system of interacting components with physical input and output.

Learning Outcome: Communication within CPS

In a professional way you analyse, design, implement, advise, manage and control communication for a CPS.

Clarification

Body of Knowledge

- Multi-device, multi-processor and multi-threaded communication
  - Synchronisation mechanisms and scheduling
- Serial communication
  - Point-to-point and broadcast networks
  - Layered communication models and how to use them
- IoT communication layers and their protocols
  - Layered communication models and how to use them
- Basic cyber security principles
  - Layered communication models and how to use them

Analysis:

- You perform an analysis yielding suitable communication for the problem domain and justify your choices.

Advice:

- You advise on protocol choices, taking into account resources, performance and security of the component communication.

Design:

- You design communication among multiple components based on an analysis.
- You elaborate on the chosen synchronisation mechanism if multithreading or multiprocessing is used.

Implementation:

- You apply multithreading or multiprocessing and related synchronisation mechanisms.
- You implement serial communication that fully adheres to the design.
- You implement a solution for IoT communication application level protocol that fully adheres to the design.

Manage and Control

- N.A.

Learning Outcome: Software Development for CPS

In a professional way you analyse, design, implement, advise, manage and control software for a CPS.

Clarification

Body of Knowledge

- Design
  - Object Oriented Analysis and Design
  - Modular Design
  - Platform independent design
- Programming in C and C++
  - Software build process
  - Memory management
  - Unit testing with mocks
- Data structures and algorithms with performance analysis

Analysis:

- You analyse the required functionality for a software system.
- You analyse the general performance aspects for a software system.
- You analyse existing components that can contribute to your solution.

Advice:

- You advise your stakeholder about impact of your design alternatives.

Design:

- You create a design for a software system that meets the following design requirements:
  - OS and hardware independence
  - Modularity
  - Testability
  - Performance
  - Memory impact

Implementation:

- You create an implementation that fully adheres to the design.
- You implement your solution according to given quality and coding standards.
- You test your implementation using unit and integration tests.

Manage and Control

- You setup and use version control.
- You use a test framework

Learning Outcome: Embedded Systems in CPS

In a professional way you analyse, design, implement, advise, manage and control hardware interfacing for a CPS.

Clarification

Body of Knowledge

- Low level hardware control
  - Hardware abstraction
  - Computer architecture
  - Embedded software development
  - Verification and validation using lab equipment
- RTOS concepts
  - Using threading, interprocess communication and mutexes
  - Embedded software development
  - Verification and validation using lab equipment
- Closed loop systems
  - Embedded software development
  - Verification and validation using lab equipment

Analysis:

- You analyse datasheets and use these to develop low level software that controls hardware components.
- You analyse signals and protocols with lab equipment.
- You analyse the required functionality for an embedded system.

Advice:

- You offer a technical advice for the hardware and software components of an embedded system.

Design:

- You design an embedded system based on the requirements.
- You design a suitable hardware abstraction layer for your embedded system.

Implementation:

- You create an implementation that fully adheres to the design.
- You implement your solution according to given quality and coding standards using defensive programming practices.
- You test your implementation using unit and integration tests.

Manage and Control

- N.A.

Professional Skills

Note: this applies to all learning outcomes.

Future-oriented Organisation

- You analyse the environment and stakeholders of the assignment.
- You substantiate the added value of a solution.
- You are familiar with ethical standards and involve social ethical issues in the judgements.
- You will independently make an inventory of sub-tasks, plan and monitor time, money, quality and ethics of the execution of the work.
- You recognise opportunities and risks and ensure future-oriented implementation, commissioning and management.

Investigative problem solving

- You determine the direction of the solution for a given problem and choose an appropriate approach.
- You solve problems methodically and creatively.

- You actively look for alternatives.
- You critically go through your own chain of reasoning.

Personal Leadership

- You present yourself professionally.
- You're being independent.
- You take others with you in your own development.
- You actively ask and give feedback.
- You strengthen your learning ability.
- You describe your professional talents, development ambitions and which professional field you aspire to.

Targeted Interaction

- You take into account different stakeholders in the assignment.
- You ensure the desired impact and execution of communication.
- You actively seek enrichment in the assignment.
- You consciously build up trust when working together.
- You work together in such a way that everyone's strengths and learning needs come into their own.
- You consciously take international differences into account.

2. Information about BA T OE3 Course Based

2.1. Introduction

Welcome to semester 3 course-based at Fontys ICT.

In this semester the education is designed according to the principles of course-based learning. The focus lies on learning in the context of real-life tasks, and on clarity and predictability of educational activities and assessments. At the beginning the education is more teacher-driven, and gradually you will take more ownership of your own learning process. You will build on your knowledge from semester 2 to further develop as an Embedded Software Engineer professional by doing more low-level embedded development, learning more about software design but also basics of RTOS, multithreading, IoT Networking and Feedback Control Systems related to the embedded software engineering.

The learning environment will be blended: it will consist of both instructions, workshops and meetings at Open ICT Lab (OIL) and online study where you can count on the support and guidance of the teaching stuff.

A considerable part of this semester will be executed in practical integrated projects that will grow in complexity. These projects will provide a way to both applying knowledge from Communication, Software Design and Embedded Systems subjects in projects relevant for the industry and to further developing professional skills.

2.2. Examination and grading

2.2.1. Examination

How is semester 3 course-based assessed?

At Fontys School of Information and Communication Technology, we use learning outcomes as the basis for the integral semester assessment. By the end of semester 3 you need to have demonstrated that you have achieved the learning outcomes. By the end of week 18 you demonstrate your learning outcome, based on your overall development during the courses and the company project.

Formative indications for the learning outcomes (Week 6, Week 12, week 18)

A formative indication is a development-oriented, interim evaluation, that is used as input for the assessor meeting. In this meeting the assessors use all the formative indications to decide on the summative, integral semester assessment. The formative indications are based on all information that is available about your development during the semester. This includes: assignments, tests, demo's, teacher feedback, observations, growth in your personal skills etc. During semester 3 you will receive the following formative indications in week 6, week 12 and week 18.

You will be judged on each learning outcome, to see how well you master it. The following 5 levels are used:

Level	Explanation
Undefined	You have not shown your development at the level described in the explanation of the learning outcome. Many essential aspects are missing in your development.
Orienting	You have made a start and explored possibilities to demonstrate the learning outcome.
Beginning	You demonstrate that you apply knowledge, insight and skills, corresponding to the learning outcome in at least one simple context.
Proficient	You demonstrate that you apply knowledge, insight and skills, corresponding to the learning outcome, in a different or more complex context.
Advanced	See proficient. Additionally, your work demonstrates excellence in both technical and professional skills.

2.2.2. Tools allowed

Every available source is allowed.

2.2.3. Resits and repairs

Because your mastery of different learning outcomes is being evaluated regularly and early during the semester, there are sufficient possibilities to satisfy learning outcomes at the required end level. This means there are no resits or repairs possible after summative evaluation at the end of the semester.

2.2.4. Grading

At the point of the semester completion, all teachers involved in this semester will determine whether the learning outcomes are met. This will be based on the formative indications received for your portfolio and overall evaluation of your achievements. No rights can be derived from the interim formative feedback. The portfolio assessment at the end of the semester is expressed using the USGO scale (Unsatisfactory, Satisfactory, Good, Outstanding). Unsatisfactory results in a semester restart.

The assessors use the guidelines below:

1. A student that has a lower than proficient level for one learning outcome receives the final grade U (Unsatisfactory)
2. A student who has for all learning outcomes at least proficient level will receive at least the grade S (Satisfactory)
3. A student who meets the second guideline and has advanced level for at least one of the learning outcome will receive the grade G (Good) or O (Outstanding)

2.3. Learning activities

Unit	Credits (EC)
Cyber-Physical Systems	30

Semester 3 T CB's Educational Unit

In this semester you study the following subjects that will lead you to mastering the learning outcomes:

Subject	Abbreviation	Study Load
Communication within CPS	COM	20%
Software Development for CPS	SD	20%
Embedded Systems in CPS	ES	20%
Project	PROJ	40%

2.4. Resources

All materials will be provided in Canvas courses. The materials will include presentations, exercises, assignments, manuals, videos etc. Some of the materials will include Open Educational Resources (OERs) from other institutes.

We expect an explorative attitude from students, which means that we expect you to find relevant, valid and trustful sources yourself and that you indicate what sources you used.

Required hardware

In the Technology domain it is important that you prove that your system works, to do this you do need measuring equipment. We expect you to buy at least a multimeter and logic analyzer yourself which you can use it throughout the entire Technology curriculum.

You can find our recommendations in the table below. These are the devices on which your teachers can give support:

Tool	Required	Alternative/better model
Multimeter	UNI-T UT132D	UNI-T UT139C (adds auto range + 6000 counts display)
Logic Analyzer / signal generator	IKALogic SQ series (SQ25, SQ50, ...)	Digilent 410-321 Analog Discovery-2 (also has oscilloscope function) Analog Devices ADALM2000 (cheaper than Digilent 410-321, comparable functionality)

Learning Management Platform

In this semester we use Canvas as learning management platform. Specific details about different subjects can be found in their Canvas courses. When a Canvas course deviates from the contents of this study guide, this study guide is leading.

Supported Software Platforms

This semester uses Linux as work environment. The easiest way to work in the same environment as the expert for your subject, is by using the provided VMWare Linux image. You are of course allowed to work in your own (Linux or something else) environment, as long as you keep in mind that said expert not always has the time or knowledge to solve specific problems in your environment.

Next to Canvas we will use Teams for online activities. You are advised to work together in groups to simulate a "day at school". We have found that this works well to motivate you for your various challenges.

2.5. Document History

Document Version	Changes
July 2020	Original document
January 2021	Added alternative Logic Analyzer in Resources/Hardware