
ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

2021-2022

Year 1

PROGRAMME SUPERVISOR

Olivier Henri ROUX



PROGRAMME ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS - Year 1

Year 1

Course unit	ECTS Credits	Course type	Course code	Title
UE100	20	Core course	SEC1_ADP	Analysis of Professional Practices
		Core course	SEC1_ENT	Business Skills
		Core course	SEC1_SI	International Experience
UE101	4	Core course	SEC1_ESE	Societal challenges for the companies
		Core course	SEC1_SSAT	Social sciences applied to work
UE102	4	Core course	SEC1_EGF	Economics and Financial Administration
		Core course	SEC1_GQ	Management of quality
UE103	16	Core course	SEC1_CN	Digital design and programmable logic device Digital design and programmable logic device
		Core course	SEC1_MAC	Microcontrôleurs : architecture et communication
		Core course	SEC1_RCA	Reseaux : concepts et applications
		Core course	SEC1_SFE	Surete de fonctionnement pour l'embarque
UE104	12	Core course	SEC1_ETS	Electronique et Traitement du signal
		Core course	SEC1_OM	Outils mathematiques
		Core course	SEC1_SMP	Specification and program modelling
UE105	4	Core course	SEC1_ANG	English
		Core course	SEC1_CE	Conférences Europe
		Core course	SEC1_PSI	PPP - International Experience

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE100

Analysis of Professional Practices [SEC1_ADP]

LEAD PROFESSOR(S): Marie GOUGEON

Objectives

- Understand the value of the business mission over the past year.
- Validate his/her knowledge of the dimensions of the engineer in charge of a mission, based on the elements of his/her experience, his/her feedback
- Enable apprentices to move from a student position to a professional position through:
 - Reflection on their learning methods and methodologies,
 - Identification of efficient practices,
 - An exchange between peers,
- Linking the two training venues: the school and the host company.

Course contents

Examples of themes: The integration of the apprentice into a company,

- Use of information and communication tools,
- In-school training,
- Peer-to-peer training,
- Ownership of the training system.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	0 hrs	6 hrs	0 hrs	0 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE100

Business Skills [SEC1_ENT]

LEAD PROFESSOR(S): Olivier Henri ROUX

Objectives

Apprenticeship training

Course contents

Apprenticeship training approximately 4-5 weeks

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE100

International Experience [SEC1_SI]

LEAD PROFESSOR(S): Olivier Henri ROUX

Objectives

To be able to prepare and carry out a stay abroad in a company, to carry out work related to one's training, to improve one's communication in a foreign language, and to broaden one's vision of work and culture.

Course contents

- Identify your network and understand how to prospect for an internship abroad.
- Analyse the construction of an evaluation tool for a mobility project.
- Appropriate a research methodology in the framework of a mobility project - Provide feedback on the experience of the international stay.
- Finalise the preparation of the financial file.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE101

Societal challenges for the companies [SEC1_ESE]

LEAD PROFESSOR(S): Stéphane GUYARD

Objectives

- Broaden the vision of apprentices around their sector of activity and in particular around the dimensions often hidden in this sector or that have not no time to work during training.
- Develop the ability to document a topic (theoretical and empirical)
- Acquire methodologies for critical analysis,
- Learn to work as a team.

Course contents

Apprentices work in teams of 3 or 4, on one theme per team.

- 1st year: bibliographic and theoretical research.
 - 2nd year: data collection and critical analysis.
- Apprentices conduct data collection to identify practices and beliefs on the ground, especially in their businesses but not only. They link data collected in the field with theoretical research done in the first year and they do a critical analysis.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 0.5)
EVI 2 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	20 hrs	0 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE101

Social sciences applied to work [SEC1_SSAT]

LEAD PROFESSOR(S): Fabien THOMAS

Objectives

- Develop a rational questioning approach as part of a practice related to human work
 - Acquire a data collection methodology adapted to this questioning
 - Learn about a human work practice
 - Connect 'practices' and 'theories' from work experience
- Apprentice engineering students (in conjunction with practice analysis sessions)
- Turn this knowledge into professional knowledge

Course contents

- Research conducted over a three-year period, based on a work situation the apprentice's host company (concretized by the writing of a brief)
- One-on-one follow-up with a worker in the SSAT module (in the questioning, the structuring the research, and correcting deliverables and memory)
- Interventions according to the following pedagogical progression:
 - Year 1: Building a problem; Observing and questioning the work; Documenting and informing oneself; Introduction to the management function; Understanding organizations; Change and innovation; Facilitating a meeting.
 - Year 2: Legal and social environment; Working as a team; Mid-Term Micro-Memory Research Defense; Post-Support Remediation Workshop; Post-Support Remediation Workshop; Evaluating the work; The field survey; Writing practice.
 - Year 3: Conduct an interview; IS and work; Welfare and work; Intercultural Management; Written Practice; Macro-Economic Vision; Support a project.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 0.5)
EVI 2 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	50 hrs	0 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE102

Economics and Financial Administration [SEC1_EGF]

LEAD PROFESSOR(S): Jean GUERNIC

Objectives

Knowing how certain economic concepts, mechanisms and theories can help to understand economic news

Analyse the main economic functions (production, consumption, investment, etc.)

Understanding the logic of economic policy, the conditions for its effectiveness and the strategies for distributing income and wealth in the face of social challenges

Course contents

Introduction: Economy and Business

Part 1. Global Issues

A/ Global developments

- o Planet Earth: changing demographics, resources and needs

- o Global issues

- o Sustainable production and consumption

B/ Changes in industrial structures

- o Modes of industrial organization

- o Societal approach to consumption

- o Balance between the economic vision and the social vision of production

Part 2. Economic agents and trade

A/ Economy: actors and decisions

- o Economic agents

- o Duties performed by agents

- o The exchanges
- o The market
- o The price
- o Exchange decisions

B/ Means of exchange

- o The evolution of the means of exchange
- o Currency: form and functions
- o The currency quantity/ activity relationship
- o The exchange rate

Part 3. Openness & wealth creation

A/ Openness of the economy

- o The development of openness
- o Trade flows
- o France's external trade
- o Instruments for measuring trade
- o The exchange rate

B/ Wealth creation

- o The concept of standard of living
- o The measure of wealth
- o Economic growth
- o Economic Development

Part 4. Social Issues: Wealth Distribution

A/ The modernised company

- o Emergence of new social logics
- o Social and societal issues
- o Consumerism and Health

B/ Social protection

- o Health Issues
- o Social security: management of accidents at work and occupational diseases
- o Social non quality costs impacting the company , the society

Part 5. Growth Drivers and Sharing

A/ Growth factors

- o Factors of production
- o The work
- o The capital
- o Technical progress
- o Multinational firms

B/ Sharing growth

- o Unequal sharing of income and wealth
- o Wage formation
- o Income redistribution: objectives and instruments
- o Redistribution Efficiency
- o The distribution of wealth worldwide

Part 6. State of play

A/ Societal situation 2020

- o Deciphering the elements of the crisis
- o The 4 interlocking crises

B/ Confrontation between neoliberal theory and reality

- o The foundations of global trade
- o Capitalism and its origins
- o Different approaches to capitalism
- o Liberalism

Conclusion: Current state of play

Course material

Sloman, S. (2013), Principes d'économie, Pearson
 Stiglitz, J. (2014), Principes d'économie moderne, De Boeck Université

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	24 hrs	0 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE102

Management of quality [SEC1_GQ]

LEAD PROFESSOR(S): Olivier Henri ROUX

Objectives

- Understanding quality approaches in companies
- To know the main indicators of service quality
- Being able to use the tools to drive quality in the company

Course contents

- Study of the basic principles of the operation of an ISO9001 quality system
- Study and evaluation of the main service quality indicators and the quality of Embedded Communication Systems
- Study of qualification procedures for the equipment concerned and QoS and QoE measurement techniques.

Course material

https://fr.wikipedia.org/wiki/ISO_9001

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	26 hrs	0 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE103

Digital design and programmable logic device Digital design and programmable logic device [SEC1_CN]

LEAD PROFESSOR(S): Olivier Henri ROUX

Objectives

Objectives:

- Master the specificities and characteristics of synchronous approaches
- Be able to implement a synchronous system and program it with different languages including grafcet and VHDL

Means :

- Study of synchronous vs asynchronous logic systems
- Practical work on a real operating part in grafcet
- Study of VHDL. Practical work on FPGA target.

Course contents

- 1) Combinatorial and sequential logic
- 2) Grafcet
- 3) VHDL and FPGA

Course material

<https://en.wikipedia.org/wiki/VHDL>

Assessment

Collective assessment: EVC 1 (coefficient 0.6)

Individual assessment: EVI 1 (coefficient 0.4)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	20 hrs	12 hrs	28 hrs	0 hrs	2 hrs

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Year 1 - UE103

Microcontrôleurs : architecture et communication [SEC1_MAC]

LEAD PROFESSOR(S): Mikael BRIDAY

Objectives

At the end of the course the students will be able to:

- understand the architecture of a microcontroller (assembly language basics);
- design a low-level driver to access a peripheral of a microcontroller and deal with microcontroller interrupts;
- design a bare metal application, i.e. without any real time operating system.

Course contents

The first part of the course deals with the software environment for deeply embedded systems:

- data representation
- cross compiler: bit operations, memory model, common C design rules, low level C and assembly specific attributes
- debugging with a JTAG probe (breakpoints, memory watch, etc)

The second part introduces some basic hardware peripherals of a microcontroller to interact with the environment:

- standard GPIO
- timers and PWM
- interrupts
- serial communication peripherals (SPI, I2C, UART)

The third part of the module focuses on the design of both bare metal applications and drivers, including concurrent execution of both software and hardware parts.

Course material

- Philip Koopman, Better Embedded Software Systems, Drumndrochit Education LLC, 2010
- D. Patterson & J. Hennessy, Computer Organization and Design – ARM Edition, Morgan Kaufmann, 2017

Assessment

Collective assessment: EVC 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	16 hrs	8 hrs	40 hrs	0 hrs	2 hrs

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Year 1 - UE103

Reseaux : concepts et applications [SEC1_RCA]

LEAD PROFESSOR(S): Laurent BOUTIER / Olivier Henri ROUX

Objectives

- Fundamental principles of computer networks.
- Be able of dimensioning and configuring a network

Course contents

- Study of network architectures, norms and standards
- Study of OSI and TCP/IP stacks.
- Implementation of the previous notions in public works: configuring and using a network.

Course material

Assessment

Collective assessment: EVC 1 (coefficient 0.4)

Individual assessment: EVI 1 (coefficient 0.6)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	34 hrs	12 hrs	0 hrs	0 hrs	0 hrs

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Year 1 - UE103

Surete de fonctionnement pour l'embarque [SEC1_SFE]

LEAD PROFESSOR(S): Olivier Henri ROUX

Objectives

- Understand operational safety issues and concepts:
- Be able to maintain a certain level of operational safety and robustness in the face of design defects, variations environment or internal process changes

Course contents

Study of the concepts of operational safety:

- Methods for qualitative and quantitative evaluation of systems and software
- Risk management: identify and assess risks, in order to implement techniques to control them (including fault tolerance).
- Certification and Standards
- Use of previous concepts to guarantee a given level operational safety and robustness

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	12 hrs	10 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE104

Electronique et Traitement du signal [SEC1_ETS]

LEAD PROFESSOR(S): Mira RIZKALLAH / Olivier Henri ROUX

Objectives

Be able to analyse and design a simple electronic circuit
Master the tools for the temporal and frequency representation of analog and digital signals and systems and perform basic processing such as filtering and digital spectral analysis.

Course contents

Signal classification, Typical signals, Approximation of signals by orthogonal functions, Series and Fourier transform, Convolution and correlation.

Signal Sampling

From continuous signal to digital signal Sampling, reconstruction and quantification.

Discrete transforms and windowing

Analysis and synthesis of digital filters

Course material

Modern Signals and Systems, H. Kwakernaak, R. Sivan, Prentice Hall.

Signals and Systems, R. Baraniuk, http://www.eng.ucy.ac.cy/cpitris/courses/ECE623_old/notes/SignalsAndSystems.pdf

Assessment

Collective assessment: EVC 1 (coefficient 0.4)

Individual assessment: EVI 1 (coefficient 0.6)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	22 hrs	14 hrs	16 hrs	0 hrs	2 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE104

Outils mathématiques [SEC1_OM]

LEAD PROFESSOR(S): Jean-Sebastien LE BRIZAUT

Objectives

master the fundamentals of applied mathematics for engineers in electronic, automatic and signal processing

Course contents

- 1- Integrations
- 2- Linear Differential Equations
- 3- Probability
- 4- Linear Optimization

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	16 hrs	16 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE104

Specification and program modelling [SEC1_SMP]

LEAD PROFESSOR(S): Myriam SERVIERES

Objectives

The objective of this course is to learn how to program in an object-oriented language. It starts with a learning/revision of the C syntax before introducing the object concepts (encapsulation, inheritance, polymorphism) as well as useful extensions to C++ programming such as exceptions and containers.

In order to learn the language in an operational way, a large number of practical exercises are planned.

Course contents

- Algorithms, specification, invariants, pre and post conditions
- Memory management: dynamic allocation, strings, arrays
- Pre and post conditions C specification, separate compilation
- Data structures: records, linear data structures and trees
- Introduction to object-oriented programming: objects and classes in C++.
- Inheritance and polymorphism, dynamic binding
- The standard C++ library
- Unit testing and code quality concepts
- versioning with Git and Github

Course material

Assessment

Collective assessment: EVC 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	15 hrs	14 hrs	39 hrs	0 hrs	4 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE105

English [SEC1_ANG]

LEAD PROFESSOR(S): James RATCLIFF

Objectives

Objectives:

- prepare students to apply for internship in English-speaking country
- prepare students for life in a company in English-speaking country
- prepare students for living abroad, integrating with English-speakers
- prepare students for TOEIC test (grammar, vocabulary, listening, reading) - required level 785

Course contents

Training program/syllabus :

Communicative approach:

- CVs in English
- Cover Letters in English
- Video CV scripts
- Describing companies and responsibilities within companies
- Job interview practice
- Telephoning for job interviews. Leaving a message
- Telephoning: arranging a meeting.
- Describing processes
- Numbers, figures, prices, measurements, alphabet, graphs, charts etc.
- Question forms
- Communication activities in various contexts - professional, social, current affairs
- Grammar review according to individual needs
- Vocabulary for TOEIC
- Professional emails
- Professional role-plays
- Presentations skills & practice
- Case studies
- Meetings language
- Social English
- Cultural Differences – working in UK, US, Australia etc

Regular Mock T.O.E.I.C practice tests

Course material

Barron's TOEIC Test 6th Edition

English Grammar in Use with answers - Raymond Murphy

Les Guides Officiels du Test TOEIC. Grammaire Vocabulaire du Test TOEIC - Hachette

L'intégrale TOEIC - Nathan

200% TOEIC 2021 - Ellipses

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	-	0 hrs	80 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE105

Conférences Europe [SEC1_CE]

LEAD PROFESSOR(S): Olivier Henri ROUX

Objectives

The Pays de la Loire Region is proposing a scheme aimed at promoting the appropriation of Europe and its political issues on its territory.

Speakers, trained in European issues and major challenges, carry out interventions as part of an educational approach initiated by the beneficiary, in order to provide the best possible response to the questions raised by this subject.

Course contents

- The construction of Europe
- The European institutions
- European citizenship

Course material

<https://www.paysdelaloire.fr/mon-conseil-regional/les-missions/europe/leurope-en-region/souvenir-leurope>

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	8 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING IN THE FIELD OF EMBEDDED SYSTEMS

Year 1 - UE105

PPP - International Experience [SEC1_PSI]

LEAD PROFESSOR(S): Alan BALL

Objectives

Be able to prepare and carry out a stay abroad in a company, to carry out work related to its training, improve its communication in language foreign, and broaden his vision of work and culture.

Course contents

- Identify the singularity of his career path to better situate himself in his professional project
- Project into the host company. Value your work experience through a video presentation.
- Identify your network and understand how to prospect for an internship abroad.
- Analyze the construction of an assessment tool for a mobility project.
- Appropriate a research methodology for a mobility project
- Return international experience.
- Finalize the preparation of the financial file.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	16 hrs	0 hrs	0 hrs	0 hrs