Real-time computer systems

Lecturer
François QUITIN (Coordinator)

Course mnemonic
ELEC-H410

ECTS credits
5 credits

Language(s) of instruction
English

Course period
Second term

Campus
Solbosch

Course content

1) Design methodology

- choice of hardware and software
- development tools for the hardware (logical analyzers, emulators, monitors) and of for the software (simulators, debuggers)

2) Real-Time Systems

- specific characteristics
- real-time software and operating systems
- real-time debug

3) Decentralized real-time architectures

- concept of network
- notion of industrial network and field busses
- industrial communication standards (RS232, RS485)
- examples of field busses (CAN, LONWorks, ProfiBus, ...)

Objectives (and/or specific learning outcomes)

- To acquire the concepts required to the design of real-time embedded systems for process control or for data processing/ transmission.

At the end of this course, the students will be able to

- design and write code in C running on a real-time operating system
- recognize and follow the good practise rules to write and document this code
- understand the link between the high level C code and the machine code
- understand the low levels problems which can occur, as well as the limitations introduced by the microcontrollers
- debug this code by using classical methods (like breakpoints and watch windows) and to realize their limits in real-time
- implement real-time debugging (logic analyzer, debug tasks, code instrumentation)
- understand the basic concepts of data-processing networks, the particular requirements of real time data exchange, and how one can meet them by by a mixture for usual networks and field busses
- distribute tasks on various processors and to define the objects of communication which they must exchange
- debug a CAN network, using an network analyzer
- make a choice among various hardware/software combinations and development tools for embedded applications

Generic competences

- Resolution of technical problem by using the acquired knowledge and with a scientific and rigorous methodology
- Team work
- Technical and interpersonal communication

Teaching method and learning activities

Lectures : 24h=12 x 2h on 6 weeks

Labs : 36h=9 x 4h on 9 weeks; project based upon a CAN network of microcontrollers

Contribution to the teaching profile

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- Present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
- Collaborate in a (multidisciplinary) team
- Work in an industrial environment with attention to safety, quality assurance, communication and reporting
- Develop, plan, execute and manage engineering projects at the level of a starting professional

- Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
- Has an in depth scientific knowledge, understanding and skills in at least one of the subfields needed to design, produce, apply and maintain complex mechanical, electrical and/or energy systems;
- Has an in-depth understanding of safety standards and rules with respect to mechanical, electrical and energy systems.

References, bibliography and recommended reading

- "Microcontroller Cookbook", Second Edition [Paperback] by Mike James (Ed Newnes)
- "Designing Embedded Systems with PIC Microcontrollers" by Tim Wilmshurst (Ed Newnes)
- "Embedded Systems World Class Design" by Jack Ganssle (Ed Newnes)
- "Embedded Networking with CAN and CANopen" by Olaf Pfeiffer, Andrew Ayre and Christian Keydel (Ed RTC books)
- "MicroC/OS-II: The Real-Time Kernel" by JJ. Labrosse (Ed CMP Books)
- "Embedded Systems Building Blocks: Complete and Ready-to-Use Modules in C", by JJ. Labrosse (Ed CMP Books)
- "Real-Time Systems" by Jane W. S. Liu (Ed Prentice Hall)

Other information

Place(s) of teaching

Solbosch

Contact(s)

Lecturer: François QUITIN

Assistants: Youssef AGRAM

Evaluation method(s)

Other

Evaluation method(s) (additional information)

1/3 of the mark is given on a project that is realized throughout the labs. There is no second session mark for the project, i.e. the first session mark of the project will count for the final grade of the course.

2/3 of the mark is given on the written exam. During the written exam, the student will receive questions that cover both theoretical and practical aspects covered during the course. The written exam is open-book, i.e. all notes are permitted.

Determination of the mark (including the weighting of partial marks)

1/3 on the lab project. There is no second session mark for the project, i.e. the first session mark of the project will count for the final grade of the course.

2/3 on the written exam.e

Main language(s) of evaluation

English

Programmes

Programmes proposing this course at the Brussels School of Engineering

MA-IRCB | Master of science in Biomedical Engineering | finalité Professional/unit 2, MA-IREM | Master of science in Electromechanical Engineering | finalité Professional/unit 1 and MA-IRIF | Master of science in Computer Science and Engineering | finalité Professional/unit 1 and finalité Professional/unit 2