Real-time computer systems

Titulaire
François QUITIN (Coordonnateur)

Mnémonique du cours
ELEC-H410

Crédits ECTS
5 crédits

Langue(s) d'enseignement
Anglais

Période du cours
Deuxième quadrimestre

Campus
Solbosch

Contenu du cours

- Chapter 1 : Introduction
  - General introduction to real-time systems and real-time networks.
  - Concept of real-time
  - Specificities of embedded systems
- Chapter 2: Microprocessor architectures
  - Basic microprocessor architecture
  - Memory technologies
  - Architectural advancements
- Chapter 3: software tools
  - From high-level source code to machine code
    - Compilers, Modular programming and Linkers
  - Software tools
    - Cross-development, IDE, debugging, Linux software tools
- Chapter 4: Real-time software: introduction and definitions
  - Tasks and jobs
  - Periodic, sporadic and aperiodic takss
  - Polling and interruption
  - Scheduling
  - Fault tolerance
- Chapter 5: clock-driven scheduling
  - Clock-driven static scheduling
  - Clock-driven dynamic scheduling
  - Overflow management
- Chapter 6: Priority-driven scheduling
  - Foreground-background systems
  - RTOS
    - Principles of a RTOS
    - Main scheduling algorithms
    - RTOS services for application programs
      - Task management
      - Time management
      - Intertask communication and synchronization
      - Dependency hazards
    - Managing interrupts
  - Choosing your RTOS
- Chapter 7: Programming languages
  - Introduction
  - Selection criteria
  - Man-machine interface
  - Real-time
- Chapter 8: Logic analyzers
  - Introduction
  - Classical logic analyzers
  - Specialized analyzers
- Chapter 9: Emulators
- Chapter 10: Networks
  - Networks in industrial processes
  - Classification
  - Architectures
    - Layers, protocols and interfaces
    - OSI model
    - TCP/IP
- Medium allocation control
  - Introduction
  - IEEE 802.3: CSMA/CD
  - IEEE 802.11: WiFi
  - (IEEE 802.5 and 802.4, but I usually drop this part)
  - Conclusions
- Control Area Networks (CANs)

- CAN vs OSI
- Layer #1
  - Medium
  - Medium dependent interface
  - Physical medium attachment
  - Physical layer signaling
- Layer #2
  - MAC protocol (CSMA/NDA)
  - Logical Link control
- Conclusions

Objectifs (et/ou acquis d'apprentissages spécifiques)

Improve knowledge on

- real-time embedded systems
- field networks

At the end of the course, the student should be able to

- design and implement a simple real-time system
- design and use a system relying on an RTOS
- understand and operate a CAN bus network

Méthodes d'enseignement et activités d'apprentissages

Lectures (24h=12x2h)

Labs (36h=9x4h) in groups of 2 to 3 students

Contribution au profil d'enseignement

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.

Support(s) de cours

Université virtuelle

Autres renseignements

Lieu(x) d'enseignement

Solbosch

Contact(s)

Titulaire: François QUITIN

Assistant: Youssef AGRAM

Méthode(s) d'évaluation

Autre, Examen oral et Projet

Méthode(s) d'évaluation (complément)

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.

Construction de la note (en ce compris, la pondération des notes partielles)

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.

Langue(s) d'évaluation principale(s)

Anglais

Programmes

Programmes proposant ce cours à l'école polytechnique de Bruxelles

MA-IRCB | Master : ingénieur civil biomédical | finalité Spécialisée/bloc 2, MA-IREM | Master : ingénieur civil électromécanicien | finalité Spécialisée/bloc 1 et MA-IRIF | Master : ingénieur civil en informatique | finalité Spécialisée/bloc 1 et finalité Spécialisée/bloc 2