Last update: 06-05-2019

230116 - DSX - Digital Systems Using Embedded Linux

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)
BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: MANUEL DOMÍNGUEZ

Others: JUAN A. CHÁVEZ, VICENTE JIMÉNEZ, JOAN PONS

Prior skills

Knowledge of the programming language C.

Teaching methodology

- Lectures.
- Laboratory classes.
- Group work (distance learning).
- Oral presentations.
- Short exams.

Learning objectives of the subject

- To know the main characteristics of embedded systems.
- To know how to schedule and manage Linux-based embedded systems, including the design of low-level software to control hardware components (drivers).
- To program and develop an interface between a Linux-based embedded system and a FPGA-based digital system.
- To know design criteria for timing clock signals management and frequency synthesis applied to programmable devices.
- To know signal processing techniques with FPGAs.
- To learn techniques of control and communication with various peripherals: ADC, Memory, etc.

Last update: 06-05-2019

230116 - DSX - Digital Systems Using Embedded Linux

Study load

Total learning time: 150h	Hours large group:	13h	8.67%
	Hours small group:	39h	26.00%
	Self study:	98h	65.33%

Last update: 06-05-2019

230116 - DSX - Digital Systems Using Embedded Linux

Content

1. Introduction to Linux embedded systems

Learning time: 20h

Theory classes: 3h
Laboratory classes: 4h
Self study : 13h

Description:

- Introduction to embedded systems: concept, system kernel, boards and development tools, process design, market and major manufacturers.
- Introduction to GNU Linux system. File system, / proc file system.
- Shell Linux commands and scripts.
- Compiling, running and debugging programs on Linux embedded systems.
- Concurrency basics: scheduler, preemptive kernels.

2. Linux programming tools

Learning time: 38h

Theory classes: 2h
Laboratory classes: 11h
Self study : 25h

Description:
- Concurrent programming: threads, forks.
- Process synchronization: semaphores POSIX, Mutexes.
- Pipes.
- Semaphores System V.

3. Driver development

Learning time: 23h

Theory classes: 2h
Laboratory classes: 6h
Self study : 15h

Description:
Using drivers:
- Control of GPIO pins with virtual files, UARTs, etc.
- Communication with standard buses (SPI, I2C, etc.)
- Module-based utilities.

Programming drivers:
- System calls: open, read, write, close, ioctl.
- Memory management.
- Managing interruptions. Managing system hardware.
- Driver control of hardware programmed in FPGAs.

230116 - DSX - Digital Systems Using Embedded Linux

4. System configuration	Learning time: 23h Theory classes: 2h Laboratory classes: 6h Self study : 15h

Description:

- Kernel compilation,
- System management, selection of applications, boot scripts.
- Source code control: GIT.
- Installation and U-Boot configuration.

5. Design technics for FPGAs	Learning time: 46h Theory classes: 4h Laboratory classes: 12h Self study : 30h

Description:

- System timing, clock management and frequency synthesis.
- Connectivity (buses).
- Signal processing with FPGAs.
- Peripherals: ADC, memories.

Planning of activities

LABORATORY	Hours: 39h Laboratory classes: 39h

Description:

Programming a Linux-based Beaglebone board and a DE-2 FPGA board, first separately and then connecting them. There will be an initial-guided lab work where programming techniques presented in class will be used. The second phase of the lab work consist either in improving the previous work or in programming an original-open project.

(ENG) PRESENTACIONS ORALS	Hours: 0h 30m Theory classes: 0h 30m

Description:

Oral presentation of the project done in the laboratory.

Last update: 06-05-2019

230116 - DSX - Digital Systems Using Embedded Linux

Qualification system

The final grade for the course comes from the course assessment (exams, work done during the course and laboratory work) and the final exam, applying the following scale:
Final exam: 15%
Controls: 10%
Projects and lab work: 75%

Bibliography

Basic:

M. Kerrisk. The linux programming interface: a Linux and UNIX system programming handbook.. San Francisco: No Starch Press, 2010. ISBN 1593272200.

Hallinan, Christopher. Embedded linux primer: a practical real-world approach. 2nd. revised ed. Prentice-Hall, 2010. ISBN 0137017839.