Embedded Systems Programming

Course Code:

CSE 326

Course Period:

Spring

Course Type:

Area Elective

Credits:

3

Theoric:

3

Practice:

0

Laboratory Hour:

0

ECTS:

5

Course Language:

English

Course Objectives:

This hands-on course introduces embedded systems and the embedded development/programming/debugging techniques. Through a series of exercises, students acquire skills in developing/programming/debug embedded Linux systems.

Course Content:

Anatomy of an Embedded System. Why embedded Linux? Processor Basics. Linux Basics. RS232. Terminal Emulators. Cross-development Environment (Native/Target compilation). Bootloaders. Setting up Network Services. Booting the Kernel (SD-Card or

NFS/TFTP). Configuring/Building linux kernel and root file system. Framebuffer, touchscreen device. Embedded Graphics, Embedded Graphics Frameworks, Qt/Qt Embedded, Virtual Framebuffer. GPIO, sysfs. Gstreamer, Gstreamer pipes, Gstreamer TI Plug-in. Loading/Unloading Device Drivers. Setting up web server. Setting up Wi-Fi module. Unofficial laboratory exercises, one Term Project.

Course Methodology:

1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study

Course Evaluation Methods:

A: Testing, B: Experiment, C: Homework, D: Project

Course Learning Outcomes	Program Learning Outcomes	Teaching Methods	Assessment Methods
1) Adequate knowledge in microprocessor architectures, embedded Linux, embedded graphics (Qt).	1,2,3,4,5	1,2,3	A, B, C, D
2) Ability to write Qt/Qt Embedded GUI applications, network applications, digital multimedia applications.	1,2,3,4,5	1,2,3	B, D
3) Ability to debug, verify, emulate embedded Linux systems.	4,5	1,2,3	B, D
4) Ability to devise, select, and use modern techniques and tools needed for embedded Linux systems.	4,5	1,2,3	B, D
5) Ability to work in a team.	6	3	B, D

COURSE CONTENT

Week	Topics	Study Materials
1	EMBEDDED OR NOT? ANATOMY OF AN EMBEDDED SYSTEM. WHY LINUX? PROCESSOR BASICS. LINUX BASICS.	Textbook
2	RS232. TERMINAL EMULATORS.	Textbook
3	CROSS-DEVELOPMENT ENVIRONMENT, NATIVE/TARGET COMPILATION, TOOLCHAINS, GDB, GDBSERVER, TI DVSDK.	Textbook
4	BIOS VERSUS BOOTLOADERS, U-BOOT.	Textbook

5	SETTING UP NETWORK SERVICES. BOOTING THE KERNEL (SD-CARD OR NFS/TFTP).	Textbook
6	CONFIGURING/BUILDING LINUX KERNEL AND ROOT FILE SYSTEM.	Textbook
7	MIDTERM 1	Textbook
8	SETTING UP WI-FI MODULE. LOADING/UNLOADING DEVICE DRIVERS. DEVICE DRIVER BASICS.	Textbook
9	GPIO, SYSFS, FILE SYSTEMS, FRAMEBUFFER, TOUCHSCREEN DEVICE.	Textbook
10	EMBEDDED GRAPHICS, WINDOWING ENVIRONMENT, QT/QT EMBEDDED, VIRTUAL FRAMEBUFFER, EMBEDDED GUI APPLICATION DEVELOPMENT.	Textbook
11	SETTING UP WEB SERVER.	Textbook
12	DIGITAL MULTIMEDIA APPLICATIONS, GSTREAMER/GSTREAMER PIPES, GSTREAMER TI PLUGIN.	Web/Open Source Library
13	MIDTERM 2	–
14	PROJECT DEMOS	–

RECOMMENDED SOURCES

Textbook	KARIM YAGHMOUR, “BUILDING EMBEDDED LINUX SYSTEMS,” O’REILLY
Additional Resources	CHRISTOPHER HALLINAN, “EMBEDDED LINUX PRIMER,” PRENTICE HALL OPEN SOURCE SOFTWARE DEVELOPMENT SERIES.

MATERIAL SHARING

Documents	coadsys.yeditepe.edu.tr/
Assignments	coadsys.yeditepe.edu.tr/
Exams	coadsys.yeditepe.edu.tr/

ASSESSMENT

IN-TERM STUDIES	NUMBER	PERCENTAGE
Mid-terms	2	50
Assignment	5	5
Lab Work (unofficial)	10	15

Term Project	1	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		0	1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.			**X**			
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.						**X**
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.						**X**
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.						**X**
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.						**X**
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.						**X**
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.	**X**					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.	**X**					
9	Awareness of professional and ethical responsibility.	**X**					

10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.	**X**
11	Knowledge about contemporary issues and the global and societal effects of engineering practices on health, environment, and safety; awareness of the legal consequences of engineering solutions.	**X**

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 12x Total course hours)	12	3	36
Hours for off-the-classroom study (Pre-study, practice)	14	2	28
Midterm examination	2	2	4
Homework	5	1	5
Project	1	45	45
Final examination	1	4	4
Total Work Load			122
Total Work Load / 25 (h)			4.88
ECTS Credit of the Course			5