

City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A 2022/2023

Part I Course Overview

Course Title:	Development and Design in Embedded Systems
Course Code:	EE5414
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P5
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: <i>(Course Code and Title)</i>	Nil
Precursors: <i>(Course Code and Title)</i>	EE3206 Java Programming and Applications or EE2331 Data Structures and Algorithms, or equivalent
Equivalent Courses: <i>(Course Code and Title)</i>	Nil
Exclusive Courses: <i>(Course Code and Title)</i>	Nil

Part II Course Details

1. Abstract

In this course, knowledge and hand on experience of on-board embedded systems are introduced. Linux kernel, device drivers, and hardware interfacing of the embedded device will be studied. Android is then used as a development platform for the embedded system in this course. Design and implementation in the Linux hardware drivers, and application software for Android will be discussed. Mini-projects and experiments with hand-on experience for implementing real-time applications will be carried out. Discovery Learning Experience (DLE), and assessment methods will be used in this course.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	A2	A3
1.	Describe the embedded Linux Kernel and Device Drivers.		✓	✓	
2.	Evaluate Android architecture and Android Runtime-Instances of Dalvik, services, Dalvik virtual machine, ART and Zygote.		✓	✓	
3.	Apply Android and port it to an embedded device, and to configure the Linux kernel and drivers to support Android.		✓	✓	
4.	Innovative design, analysis and Implementation to hardware interfacing of embedded systems for Linux or Android platforms will be discussed.		✓	✓	✓
		100%			

A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lectures	Knowledge of the general concepts Linux Kernel and Drivers. Introduction of the Android OS and driver design.	✓	✓	✓	✓			3 hrs/wk (Some of the lecturers will be conducted in the laboratory)
Tutorials	Key concepts are worked out based on questions and problem solving on embedded system.	✓	✓	✓	✓			
Case studies/ mini projects	Demonstrate the working principles and apply key concepts of embedded system under the Ubuntu Linux platform. Mini-projects to encourage students to implement the Linux or Android system with applications to the embedded device.				✓			
Laboratory	LCD driver implementation on Raspberry Pi.				✓			

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4				
Continuous Assessment: 60%								
Tests and at least 3 assignments (laboratories, laboratory reports, case studies/mini projects, and presentations etc.)	✓	✓	✓	✓			60%	
Examination: 40% (duration: 2hrs , if applicable)								
							100%	

Remark:

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. Also, 75% laboratory attendance rate must be obtained.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B,)	Marginal (B-, C+, C)	Failure (F)
1. Examination	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level

6. Constructive Alignment with Programme Outcomes

PILO	How the course will contribute to the specific PILO(s)
1,2,3,4,5	This course provides essential knowledge and techniques for innovative designing and implementing hardware interfacing with embedded systems. Students have ample opportunities to practice what they have learnt in the course with real hardware and good software development environment in the mini-project studies.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

Introduction of Embedded Linux

System Requirements, Linux Installation, Linux Boot Process, Embedded Linux file system.

Embedded Linux Kernel, Construction of Device Driver

Interfacing in Embedded Linux

Asynchronous Serial Communication Interfacing (example Minicom), Parallel Port Interfacing, USB Interfacing, Memory I/O Interfacing, Synchronous Serial Communication Interfacing and Using Interrupts For Timing.

GCC, Shell, and Python Programming

GCC compilation and debugging, Shell Script and Python Programming.

Android Operating System

Android Kernel-Binder, Power, Ashmen, PMEM, Low Memory Killer, ADB, Dalvik virtual machine, ART and Zygote.

Procedures of Porting Android Operating

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	<u>Embedded Android Porting, Extending, and Customizing</u> , by Karim Yaghmour, Publisher: O'Reilly Media Final Release Date: March 2013
----	---

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	<u>Embedded Linux Hardware, Software, and Interfacing</u> , by Craig Hollabaugh. Addison Wesley, Year!
2.	<u>Practical Linux programming : device drivers, embedded systems, and the Internet</u> , by Ashfaq A. Khan., Hingham, Mass.:Charles River Media, Inc.

3.	<u>Professional Android 2 Application Development</u> , by Reto Meier, Wiley India Pvt Ltd
4.	<u>The Android Developer's Cookbook Building Applications with the Android SDK</u> , by James Steele Nelson To, Addison Wesley
5.	<u>Bad to the Bone: Crafting Electronics Systems with Beaglebone and BeagleBone Black</u> by Steven Barrett and Jason Kridner, Morgan & Claypool Publishers.
6.	<u>Learn Raspberry Pi with Linux</u> by Peter Membrey and David Hows, [New York]: Apress, c2013.
7.	Raspberry Pi Mini-project