EE5414: DEVELOPMENT AND DESIGN IN EMBEDDED SYSTEMS

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Development and Design in Embedded Systems

Subject Code
EE - Electrical Engineering
Course Number
5414

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
EE3206 Java Programming and Applications or EE2331 Data Structures and Algorithms, or equivalent

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the embedded Linux Kernel and Device Drivers.		x	x	
2	Evaluate Android architecture and Android Runtime-Instances of Dalvik, services, Dalvik virtual machine ART and Zygote.		x	x	
3	Apply Android and port it to an embedded device and to configure the Linux kernel and drivers to support Android.		x	x	
4	Innovative design, analysis and Implementation to hardware interfacing of embedded systems for Linux or Android platforms will be discussed.		x	x	x

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 real-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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students develop knowledge of the general concepts Linux Kernel and Drivers and understand introductory concept of the Android OS and driver design.	1, 2, 3, 4	3 hrs/wk (Some of the lecturers will be conducted in the laboratory)
2	Tutorials	Students work on key concepts based on questions and problem solving on embedded system.	1, 2, 3, 4	

3	Case studies/ mini projects	Students understand the working principles and apply key concepts of embedded system under the Ubuntu Linux platform. Students work on mini-projects to to implement the Linux or Android system with applications to the embedded device.	4	
4	Laboratory	Students implement LCD driver on Raspberry Pi.	4	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	2 quizzes	1, 2, 3, 4	30	
2	3 assignments	1, 2, 3, 4	20	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

Remark: To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. # may include homework, tutorial exercise, project/mini-project, presentation

Assessment Rubrics (AR)

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good

(B+, B) Medium

Marginal

(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO 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

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

Reading List

Compulsory Readings

	Title
1	Embedded Android Porting, Extending, and Customizing by Karim Yaghmour Publisher: O'Reilly Media Final Release Date: March 2013

Additional Readings

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