EEL 4734—Embedded Operating System

Department of Electrical & Computer Engineering

Florida International University

Fall 2021

Classroom	**:**	EC 3239
Class Time	**:**	9:00 —10:15 am (M/W)
Faculty	**:**	Dr. Alexander Pons
Office Hours	**:**	M & W 10:30-12:00 am or by Appointment
Office	**:**	EC – 3145
Phone	**:**	305.348.7253
Email	**:**	aperezpo@fiu.edu
Prerequisite	**:**	EEL 2880 Applied Software Techniques in Engineering
Textbook		Chris Simmonds Mastering Embedded Linux Programming, 2nd Edition ISBN: 978-1-78728-328-2 Publisher: Packt (2017) You may purchase your textbook online at the FIU Bookstore, or download the pdf: http://centaur.sch.bme.hu/~holcsik_t/upload/Mastering%20Embedded%20Linux%20Programming%20-%20Second%20Edition.pdf

Course Description

This course is intended to provide a practical understanding of embedded operating systems. The emphasis is on the hardware and software aspects of embedded computing encompassing the composition of the embedded operating system and the development of embedded systems. It also provides students with the knowledge and skills to begin developing and implementing embedded applications with the practical aspects of embedded computing. Since the course is intended to serve students with a background in Computer Engineering related majors, computer programming skills are expected. These include C, or C++, Python programming and background of Computer Architecture. Topics covered include bootloader, Linux Kernel, and root file system

Course Objectives

1. Understand the composition of an embedded operating system.
2. Comprehension of the bootstrapping and bootloading of embedded systems.
3. Understand and be able to analyze problem and develop an embedded application.
4. Facilitate embedded operating system to develop an embedded application.
5. Understand and be able to apply basic operating system concept.

Topics Covered

1. Introduction to Embedded Operating System
2. Bootstrapping and Bootloading process
3. System-On-Chip options
4. Understanding the Linux Kernel

5. Root File System and User Space Initialization
6. Device Driver Basics
7. Understanding Memory Technology Devices
8. BusyBox tool set
9. Building embedded OS and applications
10. Development tools and cross-platform development
11. Linux/Ubuntu commands and Utilities
12. Bash, makefile, fix-ups and run-time linker

ABET Relationship of course to program outcomes:
(Select corresponding boxes below to applicable program outcomes for the course.)

☒ 1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

☒ 2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

☒ 3. an ability to communicate effectively with a range of audiences.

☐ 4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

☐ 5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

☐ 6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

☒ 7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Tentative Grading Scale

Grading Scale:		
A	**95-100**	**"Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and honestly to demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook."**
A-	**90-94**	
B+	**86-89**	
B	**82-85**	
B-	**78-81**	
C+	**74-77**	
C	**70-73**	
D	**60-69**	
F	**< 59**	

Grading Scheme

Weekly Quizzes	**5%**
Assignments	**25%**
Mid Exam	**35%**
Final Exam	**35%**
Total	**100%**

University's Code of Academic Integrity

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and honestly to demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational Mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.
More information can be found at http://academic.fiu.edu/academic_misconduct.html

Department Regulations Concerning Incomplete Grades

To qualify for an Incomplete, a student:

1. Must contact (e.g., phone, email, etc.) the instructor or secretary before or during missed portion of class.
2. Must be passing the course prior to that part of the course that is not completed
3. Must make up the incomplete work through the instructor of the course
4. Must see the Instructor. All missed work must be finished before last two weeks of the next term.

University policies on sexual harassment, and religious holidays, and information on services for students with disabilities

Please visit the following websites:
http://academic.fiu.edu/
http://drc.fiu.edu

Course Policies

- **Exams:** will be conducted in class during the class time.
- **Quizzes** will be administered during class time.
- **Attendance:** Attendance in the course is **mandatory** and a student is not allowed to miss any class during the semester. There will be a **penalty** for missing classes and it may affect your final grade.
- **Academic Misconduct:** For work submitted, it is expected that each student will submit their own original work. Any evidence of duplication, cheating or plagiarism will result at least a failing grade for the course.
- **Unexcused Absences:** Two unexcused absences are permitted during the term. More than two will result in the loss of points from your final grade. (1 point per absence above two, 3 points per absence above 5).
- **Excused Absences:** Only emergency medical situations or extenuating circumstances are excused with proper documentation. After reviewing documentation you are required to email a description of the excuse and absence dates as a written record to aperezpo@fiu.edu.

- **On Time:** As in the workplace, on time arrival and preparation are required. Two "lates" are equivalent to one absence. (Leaving class early is counted the same as tardy.)
- **Deadlines:** Assignments are due at the beginning of the class period on the date specified. Assignments submitted late (within 1 week) will receive half credit.
- To get assistance try to see me by an appointment.
- Students are encouraged to ask questions and to discuss course topics with the instructor and with each other.
- **Any work submitted should display Panther ID number and should be signed, as the students' own work, and that no unauthorized help was obtained.**
- Cell phones, communicators, MP3 players, head sets are not allowed to be used in the class.
- **DO NOT** send assignments by email.
- Instructor reserves right to change course materials or dates as necessary.

Exam policy

1. Make sure to complete the assigned homework in order to do well in the exam.
2. All exams are closed book and closed notes.
3. Use of any electronic device with keyboard is prohibited. This also applies to cellphones with messaging system.
4. No discussion is permitted during the exams.
5. Instructor is not compelled to give credit for something he cannot read or follow logically.
6. Cheating is considered as a serious offense. Students who are caught will receive the appropriate consequences.

Class Schedule

Week	Date	Weekly Topic
1	8/23	Introduction to Linux and Primer Beaglebone Black
2	8/30	Introduction to Bash
3	9/6	Makefile, Command-line arguments, conditional compilation, and Cross Development
4	9/13	Chapter 2 The Big Picture
5	9/20	Chapter 3 Processor Basics
6	9/27	Chapter 4 The Linux Kernel: A different Perspective
7	10/4	Chapter 5 Kernel Initialization Beaglebone/Linux Assignment
8	10/11	Chapter 6 User Space Initialization **Mid Term Exam (10/13)**
9	10/18	Chapter 7 Bootloader
10	10/25	Chapter 8 Device Drivers Device Driver and U-Boot loader Assignment
11	11/1	Chapter 9 File System
12	11/8	Chapter 10 MTD Subsystem
13	11/15	Chapter 11 BusyBox
14	11/22	Chapter 12 Embedded Development Environment
15	11/29	Chapter 13 Development Tools **Group Paper/Project**
16	12/6	**Final Exam**

Note: There will be weekly quizzes on Linux Topics, no make-up on quizzes.