

## EEL 4930: Microprocessor Applications 2

### INSTRUCTOR

Dr. Yier Jin [yier.jin@ece.ufl.edu](mailto:yier.jin@ece.ufl.edu) Office Hours: T 11:30AM – 1:00PM or By appointment  
Office: BEN 325

### TEACHING ASSISTANTS

Haoqi Shan [haoqi.shan@ufl.edu](mailto:haoqi.shan@ufl.edu) Office Hours: M Periods 9-10 Office: BEN 332

Kaveh Shamsi [kshamsi@ufl.edu](mailto:kshamsi@ufl.edu) Office Hours: W Periods 9-10 Office: BEN 332

### LAB NINJA

Miles Mulet [muletmiles@ufl.edu](mailto:muletmiles@ufl.edu) Office Hours: M Periods 9-10 Office: BEN 332  
Office Hours: W Periods 9-10 Office: BEN 332

### LECTURES

Periods: T4, R4-5 Location: MAEA 327

### LAB SECTIONS (NEB 281)

Monday Periods E2-E3	Thursday Periods 11-E1	Friday Periods 8-9
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### CATALOG DESCRIPTION

Implementation of a Real-Time Operating System on an ARM Cortex M processor to create more robust and complex microprocessor applications. Introduction to IoT applications.

### COURSE OBJECTIVES

To understand the benefits of using an RTOS (Real-Time Operating System) on a microcontroller. They will also learn about the architecture of ARM cortex M based processors. Students will learn the basic components of an RTOS including both background and event threads, thread scheduling algorithms, inter-process communication, thread priority, and synchronization/mutual exclusion via semaphores. Students will also learn how to design embedded C software driver libraries for peripherals such as I2C RGB LEDs drivers and a resistive, pixel-based touchscreen. Students will conclude the course by interfacing with a CC3100 Wi-Fi chip to create an IoT application.

### TEXTBOOK (recommended)

*Real-Time Operating Systems for ARM Cortex-M Microcontrollers (4<sup>th</sup> Edition)* by Jonathan W Valvano, ISBN-13: 978-1466468863, ISBN-10: 1466468866

*TI MSP432 ARM Programming for Embedded Systems* by M. Mazidi, S. Chen, S. Naimi, and M. Salmanzadeh, ISBN-13: 978-0997925913, ISBN-10: 0997925914

### HARDWARE (included)

- TI MSP432 Launch Pad
- TI CC3100 Wi-Fi Booster Pack
- TI SENSORPACK Booster Pack
- HKN IoT Development Board

### REQUIRED SOFTWARE

- TI Code Composer Studio 7
- Some HKN IoT Source Code (provided in class)

### REFERENCE MATERIALS (Available on Class Canvas)

- MSP432 Datasheet
- MSP432 Technical Manual
- ARM Cortex M4 Datasheet
- LP3943 Reference Manual
- LCD Datasheet
- CC3100 Reference Manual

### **COURSE GRADE DETERMINATION**

Exam #1	10%
Exam #2	10%
Laboratory+Quizzes	70%
Final Project	10%

### **WORKING TOGETHER**

You are encouraged to work together on exam preparations and share ideas on lab assignments. However, you are not allowed to copy or duplicate any lab material (code, drawings, etc.) from another student. This work will be considered cheating and will be dealt with in a severe manner.

### **LABORATORY RULES**

1. No food, drinks, dancing, or smoking in the Lab!
2. Students work individually on each Lab project except the Lab 5 and the final project in which you will work in groups.
3. It is the student's responsibility to return all equipment and clean her/his work area before leaving the Lab.
4. Students must attend labs during their assigned time.
5. Students must come prepared to the Lab.
6. Labs are 2 hours long. All lab hardware and software are provided to you so you can continue your lab work after the class.
7. You must show up at the standard lab starting time for check-in. If you are late, you may miss a lab quiz and thus get a zero for the quiz.

**EEL 4930 Microprocessor Applications 2**  
**Fall Semester 2018**  
 Class Schedule (Part 1 of 2)

WEEK/DAY	DATE	LAB #	Status	Lectures
1 M	1/7	Workshop		
1 T	8			What is ARM? ARM Cortex M Instruction Set
1 W	9			
1 Th	10	Workshop		ARM Cortex M Instruction Set, Intro to CCS
1 F	11	Workshop		
2 M	14	Workshop		
2 Tu	15			Intro to BSP, ARM CMSIS,
2 W	16			
2 Th	17	Workshop		MSP432 Peripherals (I2C), LP3943
2 F	18	Workshop		
3 M	21	(1)		<b><i>Martin Luther King Holiday</i></b>
3 Tu	22			NVIC, SysTick,
3 W	23			
3 Th	24	1		PendSV, MPU
3 F	25	1		
4 M	28	Workshop		
4 Tu	29			C Data Structures (Linked Lists)
4 W	30			
4 Th	31	Workshop		Real-Time Systems, Threads and Schedulers
4 F	2/1	Workshop		
5 M	4	Workshop		
5 Tu	5			Integration of SysTick, PendSV to Scheduler
5 W	6			
5 Th	7	Workshop		Basic Semaphores (Spin Lock)
5 F	8	Workshop		
6 M	11	2		
6 Tu	12			Periodic Events
6 W	13			
6 Th	14	2		Periodic Events
6 F	15	2		
7 M	18	Workshop		
7 Tu	19			Improved Semaphores, Blocking, and Yielding / Deadlocks
7 W	20			
7 Th	21	Workshop		Improved Semaphores, Blocking, and Yielding / Deadlocks
7 F	22	Workshop		<b>Homecoming</b>
8 M	25	3		
8 Tu	26			FIFO, Inter-process Communication, Sleeping
8 W	27			
8 Th	28	3		Midterm 1
8 F	3/1	3		
9 M	4			<b><i>Spring Break</i></b>
9 Tu	5		No Class	<b><i>Spring Break</i></b>
9 W	6			<b><i>Spring Break</i></b>
9 Th	7		No Class	<b><i>Spring Break</i></b>
9 F	8			<b><i>Spring Break</i></b>

## EEL 4930 Microprocessor Applications 2 Fall Semester 2018

### Class Schedule (Part 2 of 2)

WEEK/DAY	DATE	LAB #	Status	Comments
10	M	11	Workshop	
10	Tu	12		LCD Touchscreen
10	W	13	Workshop	
10	Th	14	Workshop	Thread Priority / Priority Inversion / Aperiodic Event Threads
10	F	15		
11	M	18	4	
11	Tu	19		Thread Creation and Destruction
11	W	20		
11	Th	21	4	Networking Basics: IPv4 and IPv6
11	F	22	4	
12	M	25	Workshop	
12	Tu	26		Networking Basics: TCP and UDP
12	W	27		
12	Th	28	Workshop	Networking Basics: Bluetooth
12	F	29	Workshop	
13	M	4/1	Workshop	
13	Tu	2		CC3100
13	W	3		
13	Th	4	Workshop	Final Exam
13	F	5	Workshop	
14	M	8	5	
14	Tu	9		Networking Basics: Security
14	W	10		
14	Th	11	5	Special Topic
14	F	12	5	
15	M	15	Workshop	
15	Tu	16	Workshop	Final Project Discussions
15	W	17		
15	Th	18	Workshop	Special Topic
15	F	19		
16	M	22	Final Project	
16	Tu	23		Final Project Presentation
16	W	24	Final Project	
16	Th	25	Final Project	No Class Reading Day
16	F	26		Reading Day/End of Semester!