Department of Electrical and Computer Engineering

Introduction to Microprocessor System DESIGN

Instructor	:	Dr. Herman Watson
Office Hours	:	by appointment with Zoom
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Classroom	:	TBD
Class Time	:	RVC
Web Page	:	http://web.eng.fiu.edu/watsonh/

Catalog Description:
An introduction course for Embedded Computing with solutions for connecting to the physical world using sensors, real-time software, and low power battery techniques. (3 Credits)

Prerequisites: EEL 2880 (or intro to C Language)

Reference Textbook:
MSP430FR4xx and MSP430FR2xx Family User's Guide, Texas Instruments
http://www.ti.com/lit/ug/slau445h/slau445h.pdf

Course Objectives:
1. Learn the integration of software, hardware, and low power designs used in battery powered embedded microcontroller systems
2. Learn how to sense/control the physical world with data processing hardware and software
3. Learn how to use Low Power Modes
4. Learn how to use interrupts for timing, control, and wake-up
5. Learn how to the following peripherals in Low Power modes:
    1. CPU / Memory
    2. Low Power Modes
    3. Interrupts
    4. General Purpose Digital I/O (GPIO)
    5. Clock systems
    6. Timer/Counter-Capture
    7. RS232 Communications
    8. Analog/Digital Converter
    9. I2C Communications (Accelerometer)
    10. SPI Communications (Graphic Display)
6. Complete projects with Processing graphic environment.
7. Use Energia IDE with MSPGCC C++ Compiler for all topics

Relationship of course to program outcomes:
The student will have to show:

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

Contribution of course to meeting the professional component:
Engineering Science
Engineering Design

Topics Covered:
Functional Block Design and Software Examples 1. Computer Design: Overview Energia IDE Install & Update 2. CPU Elements: 3. Peripherals (18 elements) 4. Poling vs Low Power Design 5. Low Power Modes 6. Interrupts for Wake-Up 7. Clock Sources – setup and selection 8. Timer – Count, Compare, Capture 9. Low Power Pulse Width Modulation 10. UART – RS232 communication 11. Printf(), Print Queue 12. ADC Operation and Samples - Thresholds 13. Clocked ADC Operation - Stream 14. ADC – Circular Queue - 15. SPI - Accelerometer 16. I2C – OLED Display

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 following term.

Grading Scale:	
A	92-100
A-	90-92
B+	88-90
B	82-88
B-	80-82
C+	78-80
C	70-78
D	60-70
F	< 60

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."

Grading

Topic	Percentage
Exam 1 ***no makeups***	20%
Exam 2 ***no makeups***	20%
Exam 3 ***no makeups***	20%
Exam 4 ***no makeups***	20%
Homework M01-M11	15%
M13, M14	5%

Policies:

1. **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 in at least a failing grade for the course.
2. **Absences:** Resolution of absences and materials missed are student responsibility
    1. **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).
    2. **Excused Absences:** Only emergency medical situations or extenuating circumstances are excused with proper documentation.
        1. 1. Review documentation with the lecturer,
        2. 2. email as a written record to watsonh_fiu@yahoo. (Note underscore) <<<<
            1. Name, SID, class, section, description and date of the absence
3. **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.)
4. **Deadlines: Work is due by midnight on the date specified.** Late submissions within one week will receive up to half credit. After one week, **late work will not be accepted.** Each assignment is reviewed for grades once only; late submissions are graded after the final exam. Participation deadlines are absolute – no late completions are allowed.
5. **Submissions: This class is paperless**. Submissions are made using the web form listed on the class web site. All submissions must be:
    1. a single document
    2. contain your name, date and time of completion within the document
    3. accessible by **anyone** and readable with a browser
    4. with a single URL reference. - permission: 'anyone with the link can view'.
6.
7. **DO NOT** submit work by email.
8. Instructor reserves right to change course materials or dates as necessary.

		MSP430 Architecture and Application Course – Low Power Design methods	
Mod	Week	Text: https://web.eng.fiu.edu/watsonh/IntroMicros/M0-Index/MSP430FR2433/ReferenceManualslau445g.pdf	Due Dates
M01	08/22/22	Introduction, Orders to be placed IDE and components This WEEK Order your parts before Friday>>>>>	Assignment M01-Info 08/30/22
M02	08/29/22	Blink and Button Software Examples Low Power modes – Interrupts Ref: User Guide pp 34-42 (09/02 Monday Labor Day)	Assignment M02-BnB 09/06/22
M03	09/05/22	Parallel Port Use and Initialization – Big Picture Blink ISR .. Digital I/O … Use the board Ref: GPIO User Guide p304	Assignment M03-GPIO 09/13/22
M04	09/12/22	Review 09/13 **Exam 1 09/15/21**	
M05	09/19/22	Select clock source, Set period or rate using timer, create interrupts or count period Clock sources ….Ref: User Guide p112	Assignment M05-CS 09/27/22
M06	09/26/22	Timer ISR – Timer Operation, Timer Setup and operation, Timer ISR, Blink LED With Timer ISR & Capture Mode – Serial Monitor Timer_A……..Ref: User Guide page 360	Assignment M06-Timer 10/04/22
M07	10/03/22	Timer PWM PWM – vary Green intensity and Serial Plotter Ref: User Guide page 360	Assignment M07 PWM 10/11/22
M08	10/10/22	Review 10/11 **Exam 2 10/13/21**	
M09	10/17/22	UART – setup, UART ISR, Print Queue, set BAUD rate, output text to Energia Monitor USCI Introduction: UART Mode …..Ref: page 411 User Guide Examples: Print Queue, Send Data from Count SW, Debug info?	Assignment M09-UART 10/25/22
M10	10/24/22	ADC1 – Arduino script, ADC operation, ADC Modes, ADC ISR Blink LED with threshold – Potentiometer - Serial Plotter ADC10 Operation .....Ref: page 536 User Guide	Assignment M10-ADC1 11/01/22
M11	10/31/22	ADC2 – Send Stream on UART, Encode binary and send, Energia Scope, LaunchScope Processing Graphics - Plot Potentiometer value https://processing.org	Assignment M11-ADC2 11/08/22
M12	11/07/22	Review 11/08/21, **Exam 3 11/10/21**	
M13	11/14/22	Universal Serial Communication Interface, SPI Mode..... 435 Example - Accelerometer **HiLetgo GY-291 ADXL345 3-Axis Digital Acceleration of Gravity Tilt Module for Arduino IIC/SPI Link:** http://a.co/aWvRFRi	Assignment M13-ACC Pong 11/22/22
M14	11/21/22	Universal Serial Communication Interface, I2C Mode..... 449 OLED & Potentiometer (Thanksgiving 11/24-25 Thurr-Fri) Arduino Tutorial graphics for displays SSD1306 https://youtu.be/0KO4fqiCGtw	Assignment M14-OLED Display 11/29/22
M15	11/28/22	**Review 11/29** **Exam 4 - 12/01/21**	
M16	12/05/22	**Final Exam Week** No final exam for this class	