Department of Electrical and Computer Engineering

Introduction to Microprocessor System DESIGN

Instructor	:	Dr. Herman Watson
Office Hours	:	Tuesday, Thursday
		3:00 - 5:00 pm or by appointment
Office	:	EC - 3951
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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:

(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues (in low power computer design technology)
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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, preparation, and submission are required.
4. **Deadlines: Work is due 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 (online and in class sections) See web site for instructions. All submissions must be
   1. a single document, and a brief video
   2. web accessible and readable with a browser
   3. accessible using a single URL reference to the document and another for the video.
6. **DO NOT** submit work by email.
7. Instructor reserves right to change course materials or dates as necessary.

Mod	Week	MSP430 Architecture and Application Course – Low Power Design methods	Due Dates
		http://web.eng.fiu.edu/watsonh/IntroMicros/M0-Index/MSP430FR2433/ReferenceManualslau445g.pdf Text Refence Manual – User Guide 644 Pages	Due Dates
M01	01/06/20	Introduction, Orders to be placed IDE and components This WEEK Order your parts before Friday>>>>>	Assignment M01-Info 01/10/20
M02	01/13/20	Blink and Button Software Examples Low Power modes – Interrupts Ref: User Guide pp 34-42	Assignment M02-BnB 01/21/20
M03	01/20/20	Parallel Port Use and Initialization – Big Picture Blink ISR .. Digital I/O … Use the board Ref: GPIO User Guide p304	Assignment M03-GPIO 01/28/20
M04	01/27/20	Review 1/28 – **Exam 1 Thursday 01/30**	
M05	02/03/20	Select clock source, Set period or rate using timer, create interrupts or count period Clock sources ….Ref: User Guide p112	Assignment M05-CS 02/11/20
M06	02/10/20	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 02/18/20
M07	02/17/20	Timer PWM PWM – vary Green intensity and Serial Plotter Ref: User Guide page 360	Assignment M07 PWM 03/03/20
M08	02/24/20	SPRING BREAK	
M09	03/02/20	Review 03/03, **Exam 2 Thursday 03/05,** plus Module 09 after the Exam 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 03/10/20
M10	03/09/20	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 03/17/20
M11	03/16/20	ADC2 – Send Stream on UART, Encode binary and send, Energia Scope, LaunchScope Processing Graphics - Plot Potentiometer value	Assignment M11-ADC2 03/24/20
M12	03/23/20	Review 03/24 , **Exam 3 Thursday 03/26**	
M13	03/30/20	Universal Serial Communication Interface, SPI Mode................... Ref: 435 User Guide 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 04/07/20
M14	04/06/20	Universal Serial Communication Interface, I2C Mode.................. Ref: 449 User Guide OLED & Potentiometer Arduino Tutorial graphics for displays SSD1306 https://www.electronicwings.com/ti-launchpad/oled-graphic-display-interfacing-with-msp-exp430g2-ti-launchpad	Assignment M14-OLED Display 04/14/20
M15	04/13/20	**Review Exam 4 - 04/16/20**	
M16	04/20/20	**Final Exam Week** No final exam for this class	