CPE 329: Programmable Logic and Microprocessor-Based Systems Design

Cal Poly San Luis Obispo Spring 2018

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Office Hours: Mon: 3pm-5pm, Tues: 11am-12pm, Thurs: 11am-1pm (20A-314)

Course Description: Catalog Description: Design, implementation and testing of microprocessor-based systems. Hardware/software tradeoffs (such as timing analysis and power considerations), system economics of programmable logic and microprocessor-based system design. Interfacing hardware components (such as ADCs/DACs, sensors, transducers).

Student Learning Objectives:

By the end of this course, you will be able to:

- Design and implement C programs for embedded systems
- Design a system to:
  - Generate timing delays using software delay loops and hardware timers
  - Measure the delay of events using hardware timers.
  - Generate PWM using hardware timers
  - Read and write to common buses protocols including SPI, I2C, and UART
  - Integrate and utilize a sensor with a microcontroller
  - Sample analog signals with a microcontroller using an A/D
  - Generate analog waveforms with a microcontroller using a D/A
  - Control a DC motor's rotation and speed using PWM and an H-bridge
- Identify a problem that can be solved with a microcontroller based system.
- Determine the best type of digital system, either hardware or microprocessor based
- Develop the skills to design, implement, and test microprocessor based systems
- Describe the architecture of a microcontroller and FPGA.
- Evaluate HW/SW system performance tradeoffs such as timing and power use
- Determine and evaluate system economics.
- Interface hardware components (such as switches, switch arrays, programmable I/O interfaces, real-time clocks, counters, ADCs/DACs, sensors, and transducers) to microprocessor based systems.
- Work more efficiently with partners in the design and development process.
- Read and understand a datasheet.
- Improve awareness of ethical responsibilities of an engineer

Student Responsibilities:

- Learning by participating : Courses are most successful when there is an active dialogue between the professor, your classmates, and you. If you ever have a question in class, please ask! Reading datasheets are critical to learning in this course. The recommended textbook also contains extra material and examples.
- Collaboration: Collaboration and knowing when to ask for help are key parts of being a successful engineer. You are encouraged to seek help from and provide help to any peer in this or other sections of the course. Since a major goal of the labs is to teach you how to write effective and efficient code, no sharing of another student's code is permitted. You also maynot copy code from the internet.

- Learning to learn (struggle): At your eventual job, you will never be given step by step, detailed instructions on how to do the task. If the steps were known already, you wouldn't be needed! As you progress in your classes, you will find the instructions you are given become less detailed and more open ended. This class and lab is a step in that progression. If you are stuck, try to figure it out on your own. Make sure you read all of the tutorials and documentation given. Many answers are available, you just need to read. I know it seems like there is an overwhelming amount of documentation given, but learning to read datasheets is necessary in this field. Also remember that mistakes are not a bad thing. I expect you to make mistakes! You can learn more from making mistakes than you can from having everything work perfectly the first time. The key is to learn from your mistakes and to not repeat them! I want to help you, so don't be afraid to ask a question! Understand that sometimes my answer may not be detailed, or a complete solution to your problem. Sometimes my answer may even be a question back to you. This is purposeful because I want to help you learn how to find the answers, not just give them to you.

- Assignments: Assignments will be done in pairs and submitted on PolyLearn. No late assignments will be accepted.

- Projects: Projects will also be done in pairs and must be demonstrated on or before the due date and reports must be electronically submitted on or before the due date for full credit. Late project submissions will be penalized 10% per day for up to 5 days. **No credit will be given after 5 days.**

  Students who complete all stated requirements of the projects will receive a maximum grade of 90% on the project. Additional points will be awarded to students who do something extra with the project showing deeper understanding of the material.

- Exams: All exams will be closed book, closed notes. Exam parameters, e.g. provided documents, etc. will be given prior to exams. No makeup exams unless approval is obtained prior to the scheduled test date.
- Regrade Requests: If you believe that an assignment has been graded incorrectly, you may submit a regrade request. Regrade requests must be submitted in writing within 1 week of receiving the graded assignment back.

Evaluation:

This class will use preliminary lab assignments to help assess your knowledge of the material.

- Assignments 5%
- Project 1 - Combination Lock 7%
- Project 2 - Function Generator 7%
- Project 3 - Digital Multimeter 10%
- Project 4 - Design Project 25%
- Midterm Exam 23%
- Final Exam 23%

Academic Integrity:

You are expected to conduct your academic work in accordance with the highest ethical standards of the engineering profession. Students are also responsible for knowing the University policy regarding academic honesty. Academic Honesty Policy

Students with Disabilities:

If you are a student with a disability, please consider discussing your needs and possible accommodations with the instructor as soon as possible. Persons who wish to request disability-

related accommodations should also contact the Disability Resource Center in Building 124, Room 119. Phone: (805) 756-1395 or (805) 756-6266 (TTY). Office hours are Monday-Friday from 8:00 AM – 4:30 PM. Some accommodations may take up to several weeks to arrange. DRC Web Site Accessibility Web Site

Student Mental Health:

A recent American College Health Survey found stress, sleep problems, anxiety, depression, interpersonal concerns, death of a significant other and alcohol use are among the top ten health impediments to academic performance. Students experiencing personal problems or situational crises are encouraged to contact Counseling Services (805-756-2511) for assistance, support and advocacy. This service is free and confidential.

Respect:

Students in this class are encouraged to speak up and participate during class meetings. Because the class will represent a diversity of individual beliefs, backgrounds, and experiences, every member of this class must show respect for every other member of this class.

Diversity and Inclusivity:

I am firmly committed to diversity and equality in all areas of campus life, including specifically members of diverse communities. In this class I will work to promote an anti-discriminatory environment where everyone feels safe and welcome. I am committed to providing equality of opportunity for all. We all have a responsibility not to be offensive to each other, or to participate in, or condone harassment or discrimination of any kind.

Fine Print:

These course policies are designed with the hopes of creating a fun and effective learning environment. With that goal in mind, I reserve the right to modify course policies in a reasonable manner in order to improve the course. Please feel free to send me an email at any time during the quarter with your comments on any aspect of the course.