ENGR 3410 – CRN 33088

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Microcontrollers
Spring 2024
IF YOU ARE SICK (OR POTENTIALLY SICK) – STAY HOME!
EMAIL ME – DON'T COME TO CAMPUS.

LECTURE & LAB: Tuesday & Thursday 8:00 – 10:40AM, CCCS 112

FINAL EXAM: Thursday, May 2nd, 2024 from 8:00-10:00 AM, CCCS 112

OFFICE HOURS (LSC 015): 10:00 – 11:00 AM MWF or 1:00 – 1:30 PM TTh or by appointment. Drop-ins are welcome but I can't guarantee that I will have a lot of time due to other commitments, etc. Email me to set up an appointment if these times do not work with your schedule.

GRADES: A's are 90-100%, B's are 80-89%, C's are 70-79%, etc.

Grades will be based on the following:

Component	Percentage	Format
Lab Reports & Presentations	50%	Typed in format given
Assignments / Homework	10%	Neatly written or typed
Attendance	10%	Sign-in sheet
Exams	10%	Take-home and/or lab-based exams
Design Project	20%	Details to be given.
Total	100%	

Class Schedule: (tentative)

Date	Activity	Notes
January 8 - 12:	Introduction to the Course	
January 15 - 19:	Learning Raspberry Pi Pico & Micropython	
January 22 - 26:	Raspberry Pi GPIO & Python	
Jan 29 - Feb 2:	Bit Crunching & 8bit ADC	
February 5 - 9:	Multichannel 10bit ADC	
February 12 - 16:	Analog Sensors	
February 19 – 23:	Digital Sensors	
Feb 26 - March 1:	Digital Sensors cont.	
March 4 - 8:	Pulse Width Modulation	
March 11 - 15:	PWM Applications	
March 18 - 22:	**SPRING BREAK!**	No Class or Lab
March 25 - 29:	PWM Applications cont.	
April 1 - 5:	Process Control & Data Acquisition	
April 8 - 12:	Process Control & Data Acquisition	
April 15 - 19:	Team Projects	CNSM Poster Symposium (4/19)
April 22 - 26:	Team Projects	
April 29 – May 3:	**FINALS WEEK**	Project Presentations

TEXT: There is no formal textbook for the course. We will use materials I have written as well as online resources.

SUPPLIES: Students are expected to purchase a Raspberry Pi Pico W. If you can find one with headers, great! If not, then we'll solder them on. In addition to this kit you will need a scientific calculator, writing utensils, paper etc. You will need a laptop to program the Pico W – if you don't have one we will provide one for the course. Lab safety glasses are required to be worn when in the lab as appropriate.

PHYS 3410 MICROCONTROLLERS: SENSORS, DATA ACQUISITION, AND PROCESS CONTROL An elective course for physics and engineering physics majors. This course covers the fundamental digital electronics and programming necessary to communicate with microcontroller computers and analog/digital sensors/components and interfacing between microcontroller and

sensor(s). Topics include (but not limited to) analog to digital integrated circuits (ICs), digital to analog ICs, data logging, analog sensors (temperature, pressure, etc), digital sensors (accelerometers), pulse-width modulation, and process control circuits.

ATTENDANCE: I expect you to attend all classes and labs; by now you know you cannot fully understand a technical discipline like physics without being present, on-time, and mentally alert in every class and lab. If you are sick, have a family emergency, or university sanctioned event please let me know in advance via email. Documentation for an absence will be necessary. Students who have informed me about an excused absence can make up a lab or exam at my convenience. Late work is not accepted unless for an excused absence.

EXAMS & LAB ACTIVITIES: The course involves hands-on use of the Raspberry Pi microcontroller for process control and data acquisition. Exams and related activities will be assigned to the student to demonstrate their mastery of concepts and techniques.

DESIGN PROJECTS: Students will work in teams or individually depending on enrollment to complete an engineering design project. Details of the project will be given later in the semester.

SOFTWARE: We will be using micropython for the course and Thonny (https://thonny.org/) which is a free Python IDE that works across platforms. You can also use Visual Studio.

BUILDING EMERGENCY PLAN: An Emergency Procedures Summary (EPS) for the building in which this class is held will be discussed during the first week of this course. EPS documents for most buildings on campus are available at http://uca.edu/mysafety/bep. Every student should be familiar with emergency procedures for any campus building in which he/she spends time for classes or other purposes.

TITLE IX DISCLOSURE: If a student discloses an act of sexual harassment, discrimination, assault, or other sexual misconduct to a faculty member (as it relates to "student-on-student" or "employee-on-student"), the faculty member cannot maintain complete confidentiality and is required to report the act and may be required to reveal the names of the parties involved. Any allegations made by a student may or may not trigger an investigation. Each situation differs and the obligation to conduct an investigation will depend on those specific set of circumstances. The determination to conduct an investigation will be made by the Title IX Coordinator. For further information, please visit: https://uca.edu/titleix. **Disclosure of sexual misconduct by a third party who is not a student and/or employee is also required if the misconduct occurs when the third party is a participant in a university-sponsored program, event, or activity.*

ACADEMIC INTEGRITY: The University of Central Arkansas affirms its commitment to academic integrity and expects all members of the university community to accept shared responsibility for maintaining academic integrity. Students in this course are subject to the provisions of the university's Academic Integrity Policy, approved by the Board of Trustees as Board Policy No. 709 on February 10, 2010, and published in the Student Handbook (page 37). Penalties for academic misconduct in this course may include a failing grade on an assignment, a failing grade in the course, or any other course-related sanction the instructor determines to be appropriate. Continued enrollment in this course affirms a student's acceptance of this university policy.

CODE OF ETHICS: In addition to UCA's Academic Integrity policy we will also be mindful and knowledgeable of the National Society of Professional Engineers Code of Ethics. A copy of the code can be found here: https://www.nspe.org/resources/ethics/code-ethics

STUDENT EVALUATIONS: Student evaluations of a course and its professor are a crucial element in helping faculty achieve excellence in the classroom and the institution in demonstrating that students are gaining knowledge. Students may evaluate courses they are taking starting on the Monday of the thirteenth week of instruction through the end of finals week by logging in to myUCA and clicking on the Course Evaluations task.

AMERICANS WITH DISABILITIES ACT: The University of Central Arkansas adheres to the requirements of the Americans with Disabilities Act. If you need an accommodation under this Act due to a disability, please contact the UCA Disability Resource Center, 450-3613.

STUDENT HANDBOOK: It is advisable to refer to the Student Handbook for important policies not specifically detailed in the syllabus, for example: Sexual Harassment Policy and other academic policies.

DISCLAIMER: All standard disclaimers apply. The instructor reserves the right to modify the course policies, assignments, due dates, etc. as necessary or appropriate for meeting the goals of the course.

Accreditation Board for Engineering and Technology (ABET) Outcomes:

Program Educational Objectives:
The educational objectives for the program are accessible to the public through the program webpage (https://uca.edu/physics/engineering-physics/).

The educational objectives for the program are:
Objective 1: Function as productive, qualified engineering professionals, work collaboratively and solve problems creatively in diverse professional environments in an ethical and socially conscious manner that require a fundamental understanding of the principles and practices of physics and engineering.
Objective 2: Demonstrate competency and effective communication in an engineering or science profession via promotion to positions of increasing responsibility, publishing engineering or scientific work in relevant journals, or presenting engineering or scientific work at relevant conferences.
Objective 3: Continue their education through activities such as pursuit of professional licensure, attainment of professional certifications, completion of continuing education courses, and/or enrollment in programs of graduate study in engineering or physics.

Student Outcomes:
The Engineering Physics Student Outcomes are publicly available here: https://uca.edu/physics/engineering-physics/ Students in the program are expected to know and be able to do the following by the time of graduation:

Outcome 1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
Outcome 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.
Outcome 3: An ability to communicate effectively with a range of audiences.
Outcome 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.
Outcome 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.
Outcome 6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
Outcome 7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Specific Course Outcomes:
- Students are able to program a microcontroller to take data or to control an industrial process.
- Students will extend their experimental skills and analytical approaches to physical systems.
- Students can integrate physics and engineering concepts into practical, working, circuits utilizing a microcontroller to do useful work.
- Students are able to effectively communicate what they have done to a range of audiences by writing technical reports and giving oral presentations.
- Students can demonstrate the ability to acquire new knowledge to solve a problem using appropriate learning strategies.

Student Outcomes addressed by the course:
Outcome 3: An ability to communicate effectively with a range of audiences.
Outcome 7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.