BME 210 Intermediate Design

Laboratory
Location: AME N214
Session Morning Mo, We, Fr 9-10:50am
Session Afternoon Mo, We, Fr 3-4:50pm
Lecture
Location: Biol Sci West, Rm 208
Tu 12:30-1:30pm
Homework
up to 2hrs/week
Open Laboratory
Time and Date TBD up to 2hrs/week
Course Website
https: https://sites.google.com/email.arizona.edu/bme210
Grading and Submissions
http://d2l.arizoan.edu
University required course policies
https://catalog.arizona.edu/syllabus-policies

Description of Course

This course introduces students to engineering design, development, and fabrication tools. Students will learn general concepts of mechanical, electronic and software design. We will be using an Integrated Development Environment to program a microcontroller, Computer Aided Design to create solid models, Electronic Design Automation to create printed circuit board layouts, and a subset of manufacturing processes to complete engineering projects.

Students will be assigned to teams; however each student will need to submit their individually completed projects except the final design competition which is a team effort. In the laboratory, each student will need to become proficient in the use of all tools presented in this course. Students will need to present their work in verbal, written and illustrative form.

Course Prerequisites or Corequisites

Courses

- BME 225 Intro to Computer Programming for Biomedical Engineers or ECE 175 Computer Programming for Engineering Application
- Alternatively, students need to demonstrate completion of the first 33 modules of Microsoft Python for Beginners Course and concurrently enroll in the pre-requisite courses.

Equipment

- Students need access to a computer able to run
    - Run Eagle CAD or similar electronic design program.
    - Run Python
    - A web browser that will pass https://cad.onshape.com/check.
- To run the course' single board computer without a monitor, the students need to either connect it to the ethernet port of their computer (We can provide (USB to Ethernet adapters) or to a wireless network.

Instructors and Contact Information

Instructor: Urs Utzinger
Cell Phone: (520) 258 8000
Office: BSRL 160, building requires key card access

Teaching Assistant: Carmella Ocaya, mcocaya@arizona.edu
and

Laboratory Assistant 1: Khushi Praveen, khushipraveen@arizona.edu
Laboratory Assistant 2: Isabelle O'Grady iogrady@arizona.edu

Course Format and Teaching Methods

This course is primarily a laboratory course with an accompanying lecture each week. This course will require extensive technology training and substantial references to open resources on the web. This course includes a team-based design competition.

Course Content

Please refer to the detailed course description posted on the course website as well as the course schedule.

Course Objectives and Expected Learning Outcomes

Upon completion of this course student will have

- Ability to design electromechanical systems.
- Ability to create electromechanical systems.
- Ability to control electromechanical systems.
- Ability to sense and measure.

at an introductory level.

The following ABET criteria will be addressed with this course.

ABET Student Learning Outcomes

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

The students will design software, electronic and mechanical systems.

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

The team-based design competition includes constraints and manufacturability with optimization for performance

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

Students will work in teams of 2.

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Many teaching and reference materials are available online. Students will learn how to access them and learn the proper use of digital and mechanical tools through tutorials and materials freely available to the public.

Risks and Safety

Enrolment and participation in this course impose several risks:

- Electrical shock due to improper use of tools or wiring.
- Thermal burns due to improper use of soldering equipment and other power equipment.
- Cuts or bruises due to improper use of power tools or equipment.

- Dismemberment of fingers or limbs due to improper use of power equipment or violation of the dress code.
- Loss of eyesight due to improper use of personal safety equipment.

Instructors and teaching staff will minimize those risks by training the students in proper use of equipment and requiring professional behaviors in the laboratory and adopting the laboratory environment to meet University guidelines.

Risk-mitigation is accomplished through:
- Personal Protective Equipment:
    - Eye protection will need to be always worn during laboratory hours.
- Dress code:
    - Long hair and loose clothing is a safety hazard. Precautions to avoid entanglement with equipment is required.
    - Close toed shoes are required in the laboratory.
    - You will need to be able to always hear the staff in the laboratory. You cannot obstruct hearing in both ears.
    - Protection of your skin through long pants is recommended.
- Classroom Behavior:
    - Requirements to increase safety are listed below.

Classroom Behavior Policy

Online Course Participation: For the best learning experience, I ask you to turn on audio and video during video sessions.

Mitigation of Risks:
Behavior during the laboratory, that threatens the safety of others or you, will be addressed by the instructor and course staff. If you refuse to follow requests to address improper use of equipment or improper behavior, you will be dropped from the course. If you use laboratory tools without passing proper training first, you will be dropped from the course.

Cleanup Requirements:
Constructing devices inherently produces waste materials. You are responsible to properly dispose of those materials and clean up your workplace prior to leaving the laboratory.

Fair Use of Equipment & Parts:
- Do not monopolize equipment.
- Your 3D print jobs need to complete within about one hour. If they require more time you will need to submit them at the end of the day or use other print farms on campus such as the EDC and Catalyst.
- Do not take extra parts or parts you were not instructed to take out of the course storage containers. Do not help yourself from the course material storage area.
- If the equipment at your work desk is faulty you cannot simply take the equipment from another work desk. You will need to attempt maintenance and inform the course staff of defects.
- At no time can you borrow another team's personal materials to test your device without explicit prior approval by the other team.

Equipment & Tool Storage:
There are many containers and boxes. Do not mix up the content of those boxes. They all have an inventory. If you accidentally keep a tool you borrowed from a wheeled toolbox in your personal kit, course staff will need to search in more than 60 boxes for it. If you accidentally store it in one of the workbench boxes, we will need to search through 20+ boxes to find it. If you take equipment from a workbench box with you in your kit, students from other sessions and other courses no longer have the equipment they need.

Absence and Class Participation Policy

You will need to attend the first day of class and laboratory.

Laboratory and lecture attendance is required to obtain maximum grade.

You will need to submit documentation for absences in advance, otherwise they might result in unexcused absences.

Makeup Policy for Students Who Register Late

You cannot register late for this course. You will need to complete all training and lack of proficiency in the use of software, hardware and tools cannot be substituted.

Course Communications

For course chat we use Discord: https://discord.gg/sn6KYjnhqp. You can also contact instructor and TA on Discord.

Correspondence regarding grades will need to be submitted via official University of Arizona email. If a student does not receive a response within two days, a text message should be sent to the instructor's cell phone.

Communications regarding this course will not be answered between middle of May until middle of August and during university closures.

Required Texts or Readings

Due to the novelty and interdisciplinary nature of this course, there is no textbook. We will make extensive references to external and course specific online materials.

Required Extracurricular Activities

This course has an extensive laboratory with external online training modules. Attending lectures and required laboratory hours is insufficient to gain a passing grade. The total time commitment to this course is at least 9 hours per week which exceeds the lecture and laboratory time.

Assignments and Examinations

The students will need to complete all assigned laboratories as well as the self paced online instructions on operating system, programming language, mechanical and electrical design tools.

In order to use the digital manufacturing tools (laser cutter and 3D printer) you will need to complete training.

You will be instructed in

- Soldering
- Measuring with Multimeter
- Measuring with Logic Analyzer
- Operating the Laser Cutter
- Operating the 3D Printer
- Operating a Power Drill
- Operating a Drill Press
- Operating Hand Saw and File

Improper use of those tools will contribute negatively to your grade.

There will be up to 10 laboratories. For each laboratory (excluding the equipment training laboratories).

You and your teammate will need to keep an online engineering notebook for the open design

section of the course.

For many assignments you will need to show proof of proper operation of the software or electro-mechanical system.

You will need to turn in homework assignments. Those assignments will contribute to your grade.

There will be no exams on lecture materials. There will be no final. However, all the software and devices you build during the laboratory will contribute to your grade. You will not be able to complete your laboratories without understanding the lecture materials.

Final Examination or Project

There is no final exam in this course. However, there is a design competition. Attendance at design competition is required.

Grading Scale and Policies

The grade distribution will be as following:

- Homework & Training (individual) 15%
- Laboratories 45%
    - Equipment Training 2%
    - Pi Protector 2%
    - Pi Setup 4%
    - Soldering 2.5%
    - Simon Says Game 13%
    - Motor Lab 8%
    - meArm Demo 5%
    - i2C Sensor 4%
    - i2C Sensor MQTT 2.5%
    - Manufacturing Pi-Fan Setup 2%
- Design Competition Project (team) 25%
- Lecture Quizzes 15%

Absence and Tardy:
There will be about 45 required laboratory sessions. If you arrive more than 15 minutes late or leave early, your attendance will be counted as half.

- Your laboratory attendance will be rounded up to the next 5% (80,85,90,95,100%) and then multiplied with your laboratory grade.

This course will be letter graded using the university grading system
https://catalog.arizona.edu/policy/courses-credit/grading/grading-system

It is expected that each member of a team is contributing equally: You cannot contribute equally to your team if you are not attending class or the laboratory sessions. If you have a conflict you will need to discuss with your team mate how you are going to make up the missing laboratory. Then you will inform the instructors about your plan.

Being dropped from the course because of failing to follow proper safety instructions will result in a failing grade.