ENES 100 – Introduction to Engineering Design

Young Scholars Program, July 8-26, 2019
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Meeting time / place
Monday through Friday, 9 am to 1 pm, room 1215/1116 J. M. Patterson Hall

Course Description:
This intensive 3-week course introduces students to the concepts and processes involved in engineering design. Students complete a design project on search-and-rescue robots in the setting of a damaged building. Students are divided into groups, either to form competing design teams or complementary sub-system design teams, depending on the project. The course teaches fundamentals of project planning, design practices, teamwork, innovation, and systems integration. It also includes instruction on specific engineering disciplines, such as electric circuits, mechanics, and computer programming.

Student Preparation:
This 3-week course is the equivalent of the 15-week freshman course offered at the university. The credit you receive for this class can be used at the University of Maryland. In this compressed form, each day is equivalent to a week during the regular semester. Thus, readings and homework need to be completed nearly every day.

Textbook
The course does not have a specific textbook. The fall and spring semester versions of the course have a standard textbook, which contains some information that would be useful for students in the YSP version of the course. However, the 3-week timeframe of the YSP course causes it to be significantly different from the other versions, and as a result, the applicability of the textbook is limited and does not justify its cost. All written materials and other resources necessary for the course will be provided by the instructor.

Project
The project for this course is the exploration of a simulated scenario after a multi-hazard accident, such as an earthquake, explosion caused by a gas leak, or other natural or man-made events. Deployment of a robot to scout the environment in such a situation is common, because the environment may not be safe or accessible by first responders. We will assume that the floor plan is known, and the four types of relevant hazards are (a) a fire, (b) compromised building envelope, in the form of wind, (c) exposed electrical hazard, and (d) significant water leakage. Please take a moment to familiarize yourself with the simulated accident site that your robot is to navigate autonomously.

You will learn to teach the robot to navigate through the "accident site." You will learn to program in Arduino C. Programming background is not expected, and every student is expected to learn enough to program the robot. Do not relegate this part of the course to other students on your team. Quiz questions will include programming. You will learn to sense the environment,

by using the available sensors. Additional sensors may be purchased, if they are identified early enough. In some cases, they can be built. All components must be designed and manufactured in the lab. These components may include robot arms, sensor mounting platforms, etc. Duct tape, glue, or any other ad hoc solutions are not permitted.

Equipment
The labs contain the equipment you will need for your projects. Unlike in high school laboratories, where the equipment has safeguards added to prevent damage if used improperly, the equipment in our lab has no such safeguards. Please do not use it if you are not properly trained to use any piece of equipment. Even if the equipment can be repaired, it will be weeks before they can be repaired and placed in service again; i.e. the equipment will be out of service for the remainder of the term.

Policies
1. Attendance is mandatory. Late arrivals will be penalized.
2. Class participation is also extremely important. Students are expected to contribute appropriately to their teams.
3. Homework and exams are individual work and duplication of other students' work or group work is not permitted.
4. Students must wear closed toed shoes to class to avoid injury in the assembly rooms, and must otherwise dress appropriately for the engineering design / fabrication environment.
5. Grading is based both on individual assessments (homework problems, quizzes, class participation) as well as team assessments (the final oral and written reports generated by each student team).

The breakdown of your course grade is

Homework	30%
Quiz 1	10%
Quiz 2	10%
Quiz 3	10%
Oral presentation	10%
Written report	20%
Class participation	10%

Teaching Assistants:
Heather Bacon, hbacon1@umd.edu
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Schedule

	Lecture	Lab	Demo	Homework
M 7/8	*Introduction, team formation, team photos* *Introduction of class project* *Arduino introduction*	*Lab safety* *Brainstorming design ideas*	*LEDs in different forms* *Controlling LEDs by using Arduino*	*Project ideas*
T 7/9	*Electricity, current, voltage, resistance* *Ohm's Law, Diode* *Arduino C*	*Multimeters, Equipment care* *LEDs*	*LED does not follow Ohm's Law*	*Ohm's law, diodes, etc.* *C/C++ programming* *Controlled flow and variable scope*
W 7/10	*Kirchhoff's laws* *voltage divider* *PWM*	*LCD display* *micro controllers* *Distance sensors*	*LCD display* *Voltage divider*	*Series and parallel circuits.* *C/C++ programming* *Functions and objects*
Th 7/11	*AutoDesk Inventor, Infrared LEDs and phototransistors,* *Neutral Bouyancy facility tour*	*optical encoder* *Robot driving-- Straight, 90° turn* *Slot optical switch* *Part design* *Engineering drawings*	*Simple turn control* *Anemometer*	*C/C++ programming logic* *Inventor*
F 7/12	*Binary, hexadecimal, and decimal conversion* *Inventor* *3D printing*	*Robot driving – wall following* *Binary LED timer* *Binary, hex, dec conversion* *Parts/ Assemblies* *3D part printing*	Wall-following robot 3D printing Laser cutter	*binary, hex, decimal* *Inventor* *3D print*
M 7/15	*Voltage regulators* *Wind Tunnel tour*	*Navigate course* *Flame sensor*	*Navigate course* Flame sensor	*LEDs* *Optical encoder circuits*
T 7/16	*Servo motors*	*Control of servo motor*	*Servo robot arm*	*Servo motor drive circuits*
W 7/17	*Project implementation*	*Optical measurements* *Precise robot positioning*	*Optical encoder*	*Optical encoder*
Th 7/18	*Project implementation* *Tour 3D printing facility (10 AM and 11 AM, TAP)*	*Voltage detection* *Water detection*	*TA's robot demo*	*Robot control*
F 7/19	*Project implementation*	*Fire detection* *Wind detection*	*TA's robot demo*	*Robot control*

M	7/22	*Requirements of oral and written reports* *Nuclear reactor tour (11AM - YS41)*	*Project implementation*	-	*Outline of reports*
T	7/23	*Project implementation* *Nuclear reactor tour (11AM - YS42)*	*Project implementation*	-	*Outline of oral presentation*
W	7/24	*Project implementation*	*Project implementation*	-	-
Th	7/25	*Oral presentation of final project*	*project demonstration*	-	*Final report*
F	7/26	*Troubleshooting and fine-tuning* *Written report*	*Final competition* *Pizza lunch, Clean up*	-	-