Syllabus

1 Course Description

This course is a fun, hands-on introduction to the key concepts of electrical / mechanical / computational systems. Each student will use a small mobile robot to learn about block diagrams, abstraction and modularity, energy storage and conversation, feedback and control, digital communications, and software design. The course will conclude with a multi-robot final design project. This class is for Freshman only. The course website is:
`http://www.clear.rice.edu/engi128/`

2 Prerequisites

None. All interested freshman are welcome, no previous experience or prerequisites are required.

3 Course Overview

discpline	low-level (grunge)	high-level(inspirational)
Mechanical Engineering	gears, torque & speed, transsmissions	feedback control
Electrical Engineering	bits/bytes/volts/amps, sensors	wireless communications
Computer Science	Python programming	robotics, distributed algorithms
Systems Engineering	abstraction, modularity	power systems, global localization

The curriculum covers electrical/mechanical/computational systems; with a focus on modularity, mathematical analysis, and feedback control, unifying themes in all engineering areas. The table above shows the concepts from the course. For each major, the instruction starts with a low-level "grungy" topic, and builds up to a challenging "inspirational" project that uses advanced concepts from sophomore or junior courses. Connecting theory to practice is a main goal of the course, and we will study many common, but complicated, engineering systems; hybrid cars, train locomotives, cell phones, and GPS receivers.

4 Goals

1. Understand engineering systems, especially electrical/mechanical/computational systems.
2. Understand the r-one robot as a model of an engineering system.
3. Understand which major is most interesting to you.

5 Text

None.

6 Design Challenges

There will be several in-class challenge activities over the semester. Completion of these activities is mandatory, they are an integral part of the academic content. Winning a challenge will not help your grade, but you will earn fabulous giveaways and prizes; like gift certificates to the Chocolate Bar restaurant, or small remote-controlled vehicles.

7 Robot

We will distribute a r-one (pronounced "are-one") robot to each student to use for the homework assignments and class activities. These robots are yours for the semester. Handle them with care. We will give each of you a sophisticated storage container for your robot. Not only will this help keep the robots fresh, but it will protect them from harm in your backpacks. Classes marked as "lab" or "design challenge" on the schedule will require you to have your robots in the classroom. There will be other classes where you will need them. We will announce this during lecture, and on the website. When in doubt, bring your robot to class.

8 Computers

You will need a computer to complete the robot programming assignments in this course. The best solution is for you to use your own laptop. If you do not have one, then we can arrange for you to use the OEDK computer classroom. Please talk to me if you do not have a laptop so that we can arrange access.

We have made the (very saddening) decision to not support Macs this semester. The best option for people with Macs is to use *Boot Camp* and create a basic Windows installation to run the course software. **Back up your data before you use Boot Camp**. The course staff can help you setup Boot Camp, but cannot cannot help you recover your lost files.

9 Staff

The course staff and office hours will be posted on the website. Please email questions to the entire staff: **`engi128-staff@rice.edu`**. This will ensure the quickest response from the correct person.

10 Meeting Times

Lecture: Tuesday & Thursdays, 2:30-3:45, Oshman Engineering Design Kitchen (OEDK) classroom. **Lecture attendance is mandatory**. You must register to get access to the OEDK. Please do this within the first week:
`http://oedk.rice.edu/studentaccess`

Tutorial Sections In addition to lecture, there will be a one-hour tutorial on Sunday afternoons each week. This will give you time to ask questions and get mroe help with your homework, especially when programming in Python. The first two tutorial sessions are mandatory, this is when we will get your computer setup with the software required to program your robot.

11 Collaboration

We encourage working in groups to think through the problems, and to get help in debugging your software. However everything you hand in, especially your programs, must be your own work. You must identify the people you worked with at the top of your assignments. We take the Rice Honor Code very seriously, misrepresenting your work will be dealt with harshly. It's not worth it, just do your best, and hand in your work.

12 Grading

- Problem sets (8): 70%
- Final project report and design: 10%
- Class participation: 20%

2014-10-15

There will be about eight problem sets (a.k.a. homework) this semester. Many of these will have a lab check-off that will require you to demonstrate some behavior on your robots. Homework is due in the **first 5 minutes of class on the due date**. Late homework will not be accepted. All answers must be on a separate sheet of paper, and we strongly prefer typed assignments. Work done on the handout sheet will not be graded, except when there is an explicate hand-in sheet provided.

13 Class Participation Points

We're serious about class participation. Class discussions are the best way to get your questions answered (even questions you didn't know you had), and will help all of us learn about engineering systems. In particular, answering questions incorrectly is one of the best way to start these discussions. You can be certain that you aren't the only one in the room who is confused about something, it is just that the other students are being quiet about it.

We will award class participation points (CPPs) during each class. Students start with 0 CPPs. Each student will be responsible for keeping track of their own participation points. We will review the distribution of points at the end of the semester and award full points to students who are regularly contributing to the class discussion. If we discover that full participation will not allow students to receive full points, we will change this structure as the semester progresses. Points will be awarded as follows:

- Answering a question correctly: **1 pt**
- Answering a question with "I don't know": **0 pts**
- Answering a question incorrectly, but trying your best to think through the answer: **2 pts**

You are allowed two missed lectures over the semester, as long as you give us advance warning, and have a **very** good reason for missing class. Good reasons include hospital visits, family emergencies, and serious illness (one that requires a hospital visit). Bad reasons include everything else.

14 Students with Disabilities

Any student with a documented disability seeking academic adjustments or accommodations is requested to speak with the instructors during the first two weeks of class. All such discussions will remain as confidential as possible. Students with disabilities will also need to contact Disability Support Services in the Allen Center.

15 Miscellaneous

The official course color is Safety Orange: **`http://en.wikipedia.org/wiki/Safety_orange`**. It's a powerful color, use it with care.

Date	Lecture Topic	Tutorial Topic	Problem Set
Tue, Aug 26	Lec01: Course overview, engineering systems 101, block diagrams	-	PS01: System Safari
Thu, Aug 28	Lec02: Abstraction and modularity	-	-
Tue, Sep 02	Safari round-up	-	PS01 due
Thu, Sep 04	**DC01: Cookie Crane Challenge**	-	PS02: Gears and Transmissions
Tue, Sep 09	Lec03: Transmissions, Gears, torques, BMX Physics	-	-
Thu, Sep 11	Lec04: Circuits I: Voltage, current, resistors, power multimeters r-one GUI and sensor measurements intro	Sun, Sep 14: r-one gui setup and testing (Mandatory)	PS02 due PS03: Electrical circuits, r-one sensor testing, measuring voltage
Tue, Sep 16	Lec05: Circuits II: Non-linear elements breadboards	-	-
Thu, Sep 18	**DC02: Sensor Madness**	Sun, Sep 21: Reprogram r-ones with python (Mandatory)	PS03 due
Tue, Sep 23	Lec06: Digital data, frequency, PWM Computers, microprocessors, and microcontrollers r-one software: Assembly, C, Python Python I: interactive, the rone API	-	PS04: Python Programming I: Sense, Compute, Act
Thu, Sep 25	Lec07: Python II: Variables, types, loops, conditionals	Sun, Sep 28: Problem set help session	-
Tue, Sep 30	Lec08: Python programming III Data structures: Tuples, Lists, dictionaries Sense, Compute, Act	-	-
Thu, Oct 02	**DC03: Insect Wars**	Sun, Oct 05: Problem set help session	PS04 due
Tue, Oct 07	Lec09: Measuring distance, odometers of all types Measuring speed, motor control	-	PS05: Python Programming II: My Simon
Thu, Oct 09	Lec10: Feedback control, PID Control	Sun, Oct 12: Problem set help session	PS05 due (on 10/10) PS06: Feedback control
Tue, Oct 14	Midterm Recess	-	-
Thu, Oct 16	Lec11: Energy I: Storage, conversion, transmission, dissipation	Sun, Oct 19: Problem set help session	-
Tue, Oct 21	Lec12: Energy II: Vehicles and energy	-	-
Thu, Oct 23	**DC04: Robot croquette**	Sun, Oct 26: Problem set help session	PS06 due
Tue, Oct 28	Lec13: Communications: bits, bytes, ASCII, bandwidth	-	PS07: Robotics and Communications (Follow-the-Leader)
Thu, Oct 30	Lec14: Inter-robot communications, Local coordinate systems	Sun, Nov 02: Problem set help session	-
Tue, Nov 04	Lec15: Communication networks IR comms demo	-	-
Thu, Nov 06	**DC05: IR Olympics Judging** Lec16: Global Coordinates I: Pose, South-Facing Chariot	Sun, Nov 09: Problem set help session	PS07 due PS08: Global coordinates, waypoint navigation
Tue, Nov 11	Lec17: Global Coordinates II: Longitude, GPS	-	-
Thu, Nov 13	Lec18: Final challenge intro, group brainstorming Distributed Algorithms: Consensus and agreement	Sun, Nov 16: Problem set help session	-
Tue, Nov 18	**DC06: Tic-Tac-Toe**	-	PS08 due
Thu, Nov 20	Lec18: Final challenge intro, group brainstorming Distributed Algorithms: Consensus and agreement	Sun, Nov 23: Problem set help session	PS09: Final project report
Tue, Nov 25	Lec19: Robotics I: Controllers, Finite state machines Robotics II: Behavior-Based control, System design	-	-
Thu, Nov 27	Thanksgiving	-	-
Tue, Dec 02	Lec20: Course Review	-	-
Thu, Dec 04	**DC07: Final challenge**	-	Final project report due