ECE 425: **Mobile Robotics***
Winter 2012 - 2013
2R-4L-4C W

Description:
This course will introduce the basic principles of mobile robotics history, theory, hardware and control. Topics will include robot components, effectors and actuators, locomotion, sensors, feedback control, control architectures, representation, localization and navigation. This is a project-oriented course and the student will have hands-on experience with a real mobile robot. The student will be required to complete several laboratory assignments and a multidisciplinary team design project.

Prerequisites: ECE 320 or ME 406 (Control Systems) required
Programming Proficiency (JAVA, C# preferred) or
Instructor permission

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Required Textbook:
Berry, C.A., "Mobile Robotics for Multidisciplinary Study", Synthesis Lectures on Control and Mechatronics, Morgan and Claypool, 2012.

References:
1. Arkin, Ronald C., "Behavior-Based Robotics", The MIT Press, 1998
2. Bekey, George A., "Autonomous Robots: From Biological Inspiration to Implementation and Control", The MIT Press, 2005
3. Jones, Joseph L., Flynn, Anita, M., and Seiger, B.A., "Mobile Robots: Inspiration to Implementation", AK Peters, 1999
4. Martin, Fred G., "Robotic Explorations: An Introduction to Engineering through Design", Prentice Hall, 2001
5. Matarić, M.J., "The Robotics Primer", The MIT Press, Cambridge, Massachusetts, 2007, 300 pp, ISBN 0-262-63354-X
6. Murphy, Robin R., "Introduction to AI Robotics", The MIT Press, Cambridge, Massachusetts, 2001, 466 pp, ISBN 0–262-13383-0
7. Siegwart., R. and Illah R. Nourbakhsh, "Introduction to Autonomous Mobile Robots", The MIT Press, 2004. (http://autonomousmobilerobots.epfl.ch/)
8. Kortenkamp, D., Bonasso, R.P., and Murphy, R., (Eds.), "Artificial Intelligence and Mobile Robots: Case Studies of Successful Robot Systems", The MIT Press, 1998.

Hardware and Software:
CEEN-BOT programmed with C using an Atmel AVRISP II In-System Programmer
http://www.ceen.unomaha.edu/CEENBoT/API/CEENBoT_API_Fundamentals.pdf
You will receive a base robot with all of the peripherals including batteries and charger on the first day of class. You and your lab partner will check out the robot for the quarter and it must be returned by the first day of finals week at the end of the quarter. You and your lab partner are solely responsible for the robot's care and security. If the robot is **not** returned with all peripherals in its original condition, you will receive an incomplete in this course. If it is lost, you must purchase the robot and peripherals at

a cost of **$500** in order to receive a grade in this course. The robot must be returned to the instrument room in the same condition it was received or the student will be charged the complete cost of repair or replacement.

Grading:
Grades will be assigned at the end of the quarter based on the grade weights and grading scale shown below:

Participation	10%	A	90 – 100
Quizzes	30%	B+	87 - 89
Laboratory Assignments	30%	B	80 – 86
Final Project	30%	C+	77 – 79
		C	70 – 76
		D+	67 – 69
		D	60 – 66
		F	Below 60

Participation:
Classroom participation actually counts toward your grade in this class. Not participating in classroom activities or excessive absences will have a measurable detrimental effect on your grade. You are expected to be attentive and engaged in the lecture (i.e. not sleeping, reading the newspaper, surfing the web, doing homework for other courses, disturbing others with electronics). As a rule of thumb, you should expect to put in **eight hours** per week outside of class reading the text, preparing for quizzes, completing the laboratory assignments and final project.

Quizzes:
There are no exams in this course; however there will be weekly quizzes over the required reading and lectures. These quizzes will represent **30%** of your grade, equivalent to two exam grades. The required reading includes not only the textbook but literature that will be posted to the Moodle course website. Reviewing literature in the field is important because robotics is a very theoretical and application-based field; therefore there is minimal benefit to working with the robot in lab and not being informed about robotic history, theory and application. Thus, it is *very important* that you complete all of the required reading and be conscientious about preparing for these quizzes.

Laboratory Assignments:
The purpose of the laboratory assignments is to develop the robot's human-robot interface and basic behaviors in order to increase its artificial intelligence. In addition, these components will build upon each other from week to week to will help the student team prepare for the final project. Thus, it is *very important* not to do a get job on the primitive behaviors and not get behind because this will prove detrimental in future labs.

All of the programming will be completed in C Each student is required to have a basic programming proficiency and is expected to be able to perform object oriented programming independently even in an unfamiliar language. Since this is not a programming course, students will be provided with only a very brief lecture on the programming environment and starter code on the first day of class and expected to learn the rest independently. A very useful reference for C is the MSDN library.
There are also numerous web resources for C tutorials available by performing a search.

Each week, the laboratory assignment grade will include a demonstration and submission of the well-documented code and lab memo (technical report). The code and memo should be zipped in a file and uploaded to the course Moodle Lab DropBox by **midnight on the Sunday** after the demonstration.

Laboratory reports must follow the format provided by the instructor. One laboratory report should be submitted per team and should be a product of the joint effort between the members. The team member roles should alternate on a weekly basis between programmer, technician and reporter.

If there is a pre-lab associated with a laboratory assignment, it will be due at the beginning of the class prior to the laboratory demonstration. The pre-labs, demonstration and reports will receive a **20% late penalty** per day if not submitted on time. A missed laboratory assignment **must** be made up but the students may not receive full or any credit for the lab.

Since this is a very hands on course, **always** bring your laptop computer and the robot fully charged to class. If possible, use the slow charger (~5 hours) to charge the robot overnight before class because it provides a longer and better charge than the RC quick charger.

There are no exams or homework in this course by design because it is expected that the labs will require a significant time commitment.

Final Project:

The final project report and demonstration will be due during the last couple of weeks of class. The final project demonstration typically involves a team exhibition and class competition in the student union. The final report must follow the same format as the laboratory reports. **No incomplete will be given on the final project.**

Course Policies:

- Students are encouraged to check their RHIT email account daily for information regarding the class. You are responsible for all information sent to your account from the professor, whether read or not.
- All students are expected to join in class discussion and all activities with a positive attitude. All students are expected to exhibit an attitude that is appropriate to one studying a profession and such that everyone has an engaging, fulfilling and successful experience. Please leave the classroom neater than you found it.
- Operating your computer in class for anything other than an approved course activity is not permitted. Students must not hinder the learning environment of their fellow classmates with any other distracting behavior such as talking, sleeping or reading the newspaper. Continued disruptive conduct will lead to the student being asked to leave class and marked absent for that class period. The student will remain responsible for all class assignments.

Attendance:

- Regardless of whether formal attendance is recorded, attendance at each class is expected. Experience has shown that regular attendance and engagement improves learning and consequently improves quiz and assignment performance. According to the Academic Rules and Procedures, "A student whose total absences in a course, excused or unexcused, exceed two per credit is liable to fail the course." For the purposes of this class, that limit will be set at **no more than 8 absences per quarter**.
- If you must be absent from class for any reason including a job interview or illness, you must let the instructor know as far in advance as possible.
- Students are responsible for all information presented in class whether present or not.

Honor Policy:

Rose-Hulman Institute of Technology does not tolerate plagiarism or cheating in any form. The penalties for these and other forms of academic misconduct range from a lowered course grade, through failure in the course, up to and including suspension from the Institute.

Excused Absence (RHIT Academic Policies):
Instructors will normally permit make-up work to be done when a student has legitimate conflicting obligations, such as illness or emergency, Institute-sponsored activities, plant trips or interviews. These conflicts do not excuse the student from course responsibilities. The student is responsible for informing the instructor of any legitimate excuses and making arrangements for make-up work, if permitted, as soon as possible. Whenever possible, the student must discuss unavoidable absences with instructors in advance.

***Disclaimer:**
This is the fourth time this course is being offered and it is under continual update and development. Therefore, the instructor requests flexibility and patience as the course materials, format, robot hardware, quizzes laboratory assignments are evaluated and modified as deemed necessary. In addition, although a robotic platform is a great learning resource, it is ***not perfect***. However, this platform does provide you with exposure to real-world open research areas in robotics (odometry, sensor and bandwidth error) and you are expected to work around these deficiencies to complete all assignments.