



**ECE 497: Special Topics: Introduction to Mobile Robotics\***  
Spring 2006 - 2007  
3R-3L-4C

**Description:**

This course will introduce the basic principles of mobile robotics hardware, control and design. Topics will include mobile robot simulation, electrical actuators, effectors, robot locomotion and kinematics, sensors, control, navigation, localization, path planning. There will also be a very brief introduction to computer vision, image processing, Human-robot interaction and GUI design. This is a project-oriented course and the student will be required to complete an interdisciplinary team design project as well as several laboratory projects. The student will have hands-on experience with a real mobile robot and will be required to program the robot to implement some simple behaviors to achieve design specifications for the final project.

**Required Textbook:**

Siegwart., R. and Illah R. Nourbakhsh, "Introduction to Autonomous Mobile Robots", The MIT Press, 2004. (<http://autonomousmobilerobots.epfl.ch/>)  
Supplemental Reading provided by Instructor

**Prerequisites:** Junior level classification,  
Majors (CpE, EE, ME, CS or other related disciplines)  
Programming Proficiency (JAVA, C, Basic)

**Instructor:** Dr. Carlotta A. Berry, Assistant Professor, Electrical and Computer Engineering  
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office hours: MTWF – 6th hour, Thursdays by appointment

**References:**

1. Craig, John J., "Introduction to Robotics: Mechanics and Control", Prentice Hall, 2003.
2. Jones, Joseph L., Flynn, Anita, M., and Seiger, B.A., "Mobile Robots: Inspiration to Implementation", AK Peters, 1999
3. Martin, Fred G., "Robotic Explorations: An Introduction to Engineering through Design", Prentice Hall, 2001.
4. Murphy, R.R., "Introduction to AI Robotics", MIT Press, 2001
5. Niku, S.B., "Introduction to Robotics Analysis, Systems, and Applications", Prentice Hall, 2001.
6. Schilling, R.J., "Fundamentals of Robotics: Analysis and Control", Prentice-Hall, 1990.

**Hardware:** Traxster Robt Kit programmed with the SBC44B PIC microcontroller  
<http://www.roboticsconnection.com/pc-15-3-traxster-robot-kit.aspx>

**Grading:**

Homework	20%
Participation	5%
Labs	25%
Midterm Exam	25%
Final Project	25%

**Grading Scale:**

A	90 – 100
B+	87 - 89
B	80 – 86
C+	77 – 79
C	70 – 76
D	60 – 69
F	< 60

**Participation:**

Classroom participation actually counts towards your grade in this class. Not showing up to class will have a measurable detrimental effect on your grade.

**Homework Assignments:**

Homework will be assigned on a bi-weekly basis and is due at the beginning of class. Homework submitted after the double bell will receive a 20% late penalty. Homework not received by 5 pm on the day that it is due will receive a zero. You are encouraged at all times to discuss course material with your classmates and to help each other to understand and assimilate the concepts presented. Nevertheless, a distinction is made between helping someone to understand concepts and providing someone with specific answers. When you actually write out your solutions to the homework problems, it is expected that you will work individually, without reference to other students' work. Remember that help with these problems can also be obtained from the textbook, library, internet and the course instructor.

**Exams:**

There will be **ONE** examination given during the quarter. If the exam is missed for an excused absence (bereavement, job interview, university activity)<sup>†</sup>, the instructor must be notified before the event. The student must make up the exam within a week of the exam to receive credit. All examinations will be closed book and closed notes. All requests for regrades on examinations and homework must be submitted in writing and attached to the document to be reviewed. Based upon the request, the student's grade may increase, decrease or remain the same.

**Laboratory Assignments:**

Laboratory assignments will be small projects with reports due every week or every other week. The purpose of the laboratory assignments is to prepare you to complete the final project. These will be used to develop some of the basic behaviors required for the final project. 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 experiment. The pre-labs and lab reports will also receive a 20% late penalty if not submitted at the beginning of the class when they are due. The student must complete the pre-lab before starting the lab but will receive a grade of zero if it is after 5 pm on the day it is



due. All experiments must be completed by the laboratory team in order to receive a passing grade in the course. It is not acceptable to send your lab partner to complete the laboratory experiment. A missed lab **must** be made up but the students may not receive full or any credit for the lab report. **Always** bring your laptop computer and ES203 lab kit (if you have one) to lab. 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 members should alternate roles on a weekly basis (programmer, secretary, technician).

### **Final Project:**

The final project report will be due on the last day of class. During the last week of school, each team will demonstrate their working project and submit the report and lab notebook. The final project demonstration may involve a team exhibition as well as a class competition. The final report must follow the same format as the laboratory reports. Each student will be required to submit confidential self and peer evaluations several times throughout the quarter. These evaluations will be your only opportunity to share information about your team dynamic and should be honest and fair. It should be noted that it is possible for members of the same team to receive different grades on the final project. **No incomplete will be given on the final project.**

### **Course Policies:**

- 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.
- 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 a successful and fulfilling experience. Please leave the classroom and laboratory neater than you found it.
- Students must not bring any electronic, noise- or light-emitting devices, such as beepers, mobile phones, palm pilots, IPODS, etc., that can distract or disturb its owner or others to class. Mobile telephones are not to be used during class for any purpose, including making or receiving calls, photographs, text messages, or playing games. Students may not wear headphones or ear buds in class. 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.
- Students are encouraged to check their RHIT email account daily for information regarding the class, the homework, exams and the labs. You are responsible for all information sent to your account from the professor, whether read or not.
- Students will be required to check the robot from the instrument room for use before, after or during class. The student team should use the **same** robot for all assignments completed for the quarter. The robot is never to be removed from the building under any circumstances. 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.



**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 test and homework 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**.
- 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):**

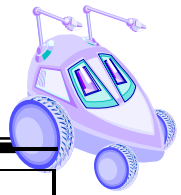
- Instructors will normally permit make-up work to be done when a student has legitimate conflicting obligations, such as illness or emergency, Institute-sponsored activities, or plant trips. These conflicts do not excuse the student from course responsibilities. The student is responsible for informing 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 first time this course is being offered and is therefore still under development. Therefore, the instructor requests flexibility and patience as the course materials, format, hardware and homework, laboratory assignments are evaluated and modified as deemed necessary.

**Course Schedule\* :**

Class	Day	Date	Topic	Assignment Due
1-1	M	3/5/07	Introduction (Ch. 1)	
1-2	T	3/6/07	Effectors and Actuators (Ch. 1)	
1-3	R	3/8/07	Effectors and Actuators (Ch. 1)	Pre- Lab 1
1-L	F	3/9/07	Lab 1 – Dead Reckoning	
2-1	M	3/12/07	Locomotion/Kinematics (Ch. 2, 3)	
2-2	T	3/13/07	Locomotion/Kinematics (Ch. 2, 3)	Homework 1
2-3	R	3/15/07	Locomotion/Kinematics (Ch. 2, 3)	Pre-Lab 2
2-L	F	3/16/07	Lab 2 - Feedback Control	Lab 1 Report
3-1	M	3/19/07	Locomotion/Kinematics (Ch. 2, 3)	
3-2	T	3/20/07	Locomotion/Kinematics (Ch. 2, 3)	
3-3	R	3/22/07	Locomotion/Kinematics (Ch. 2, 3)	Pre – Lab 3
3-L	F	3/23/07	Lab 3 – Obstacle Avoidance/ Wall Following	Lab 2 Report
4-1	M	3/26/07	Sensors/Perception (Ch. 4)	



4-2	T	3/27/07	Sensors/Perception (Ch. 4)	Homework 2
4-3	R	3/29/07	Sensors/Perception (Ch. 4)	Pre-Lab 3
4-L	F	3/30/07	Lab 3 – Obstacle Avoidance/ Wall Following	
5-1	M	4/2/07	Sensors/Perception (Ch. 4)	Peer Evaluation
5-2	T	4/3/07	Mobile Robot Localization (Ch. 5)	
5-3	R	4/5/07	Lab 3 – Obstacle Avoidance/ Wall Following	Pre-Lab 4
5-L	F	4/6/07	Lab 3 – Obstacle Avoidance/ Wall Following	Lab 3 Report
6-1	M	4/16/07	Mobile Robot Localization (Ch. 5)	
6-2	T	4/17/07	Mobile Robot Localization (Ch. 5)	
6-3	R	4/19/07	Lab 4 – Object Detection/Robot Following	Pre – Lab 5
6-L	F	4/20/07	Lab 4 – Object Detection/Robot Following	Lab 4 Report
7-1	M	4/23/07	Planning and Navigation (Ch. 6)	Peer Evaluation
7-2	T	4/24/07	Planning and Navigation (Ch. 6)	
7-3	R	4/26/07	Lab 4 – Object Detection/Robot Following	Homework 3
7-L	F	4/27/07	Lab 4 – Object Detection/Robot Following	
8-1	M	4/30/07	Planning and Navigation (Ch. 6)	
8-2	T	5/1/07	<i>Test (Lectures 1 – 6)</i>	
8-3	R	5/3/07	Lab 5 – Navigation/Path Planning	
8-L	F	5/4/07	Lab 5 – Navigation/Path Planning	Lab 5 Report
9-1	M	05/7/07	Final project – Hide and Seek	Peer Evaluation
9-2	T	05/8/07	Final project – Hide and Seek	Homework 4
9-3	R	05/10/07	Final project – Hide and Seek	
9-L	F	05/11/07	Final project – Hide and Seek	
10-1	M	05/14/07	Final project demonstrations	
10-2	T	05/15/07	Final project demonstrations	
10-3	R	05/17/07	Final project demonstrations	
10-L	F	05/18/07	Final project team competition	Final Project Report Peer Evaluation

\*This course is under development and the schedule, topics and assignments may be modified at the discretion of the instructor