## DEPARTMENT: MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>EML 4830-1/5831-1, 3 credits</th>
<th>COURSE TITLE: Introduction to Mobile Robotics</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE COURSE: Dynamic Systems Elective</td>
<td>TERM: Spring 2008</td>
</tr>
<tr>
<td>CATALOG DESCRIPTION: Analytical dynamic modeling and dynamic simulation of mobile robots; mobile robot sensors; basic methods of computer vision; Kalman filtering and mobile robot localization; basic concepts of mapping; path planning and obstacle avoidance; intelligent control architectures</td>
<td>PREREQUISITES: Graduate standing or instructor’s approval.</td>
</tr>
<tr>
<td>AREA COORDINATOR: Dr. Emmanuel Collins</td>
<td>CLASS SCHEDULE: MW 10:45am – Noon</td>
</tr>
<tr>
<td>RESPONSIBLE FACULTY: Dr. Emmanuel Collins</td>
<td>LABORATORY SCHEDULE: The lab times and meeting place(s) will be announced throughout the semester.</td>
</tr>
<tr>
<td>INSTRUCTOR OF RECORD: Dr. Emmanuel Collins, Rm. B346, 410-6373, <a href="mailto:ecollins@eng.fsu.edu">ecollins@eng.fsu.edu</a></td>
<td></td>
</tr>
<tr>
<td>ADDITIONAL INSTRUCTORS: Dr. Oscar Chuy (Sensors, Lab TA), Rm.B360, 410-6389, <a href="mailto:chuy@eng.fsu.edu">chuy@eng.fsu.edu</a></td>
<td></td>
</tr>
<tr>
<td>DATE OF PREPARATION: 1/04/08 EC</td>
<td></td>
</tr>
<tr>
<td>SCIENCE/DESIGN (%): 70%/30%</td>
<td>CONTRIBUTION TO MEETING THE PROFESSIONAL COMPONENT: 70% Engineering Science 30% Engineering Design</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES* (Numbers shown in brackets are links to department educational outcomes)

1. To provide an overview of the key concepts related to designing and implementing mobile robots in practical applications. [1,3,4,5,8,9,10]
2. To provide an overview of the basic sensors used in mobile robots and the ways that these sensors are characterized. [1,2,10,11]
3. To introduce the concept of Kalman filtering and mobile robot localization. [1,2,10,11]
4. To introduce basic issues in computer vision for mobile robotics. [1,2,10,11]
5. To present standard path planning and obstacle avoidance algorithms. [1,2,10,11]
6. To provide a broad overview of topics in human-robot interaction. [3,4,6,8,10]
7. To provide hands-on experience in designing and modeling a simple mobile robot. [2,5,10,11]

COURSE OUTCOMES* (Numbers shown in brackets are links to course objectives listed above)

1. Be able to describe a wide variety of autonomous vehicles and their industrial or military applications. [1]
2. Be able to describe the major physical subsystems associated with mobile robots. [1]
3. Be able to discuss the different levels of autonomy for mobile robots. [1]
4. Be able to describe the basic types of mobile robot sensors and the principle of operation of a given sensor type. [2]
5. Be able to discuss the way sensors are characterized and the precise meaning of a given sensor characteristic. [2]
6. Be able to design and simulate a Kalman filter for simple navigation problems. [3]
7. Be able to describe the basic issues in computer vision for mobile robot applications. [4]
8. Be able to describe and program the A* algorithm for path planning. [5]
9. Be able to describe potential field path planning. [5]
10. Be able to describe several obstacle avoidance algorithms. [5]
11. Be able to describe the major topics in human-robot interaction. [6]
12. Be able to design and build a simple mobile robot. [7]
13. Be able to construct and calibrate the kinematics of a differentially-steered vehicle. [7]

ASSESSMENT TOOL DETAILS

GRADING

The class can be considered divided into five sections: 1) Introduction & Research (10%), 2) Sensors & Sensor Fusion (20%), 3) Path Planning & Obstacle Avoidance (20%), 4) Human-Robot Interaction (20%), 5) Lab (30%).

- The Introduction & Research section involves the material in the Introduction to the class, along with the presentation of research being conducted at the FAMU-FSU COE, which will be discussed throughout the semester.
- The research presentations may be conducted by students or faculty who are not official class instructors. Short quizzes of a qualitative nature will be given on the research presented during the next class period.
- One exam will be given for each of the remaining sections, with the exception of Lab. The weighted average grade will be calculated using the percentages that are given with each of the five sections. The final course grade will be calculated using the following scale:

<table>
<thead>
<tr>
<th>Passing Grades</th>
<th>Failing Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 – 100</td>
<td>60 – 69</td>
</tr>
<tr>
<td>80 – 89</td>
<td>0 – 59</td>
</tr>
</tbody>
</table>
Departmental policies are that a grade of C or better is required to pass the course.

**The instructor reserves the right to revise the grading scheme.**

**LABORATORIES**

For the Lab section, each student will be assigned a lab group and remain in this group for the duration of the course. Each group will turn in a single lab report for each laboratory.

The following 4 labs are currently planned:

1. Mobile Robot Platform Development (3 weeks)
   - Mobile robot assembly
   - Programming familiarization
   - Motor and sensor calibration
2. Reactive Behavior Implementation (1 week)
   - Development of reactive behavior based distance sensor
3. Wall Following (1 week)
   - Development of motion control algorithm for wall following
4. A* Implementation (2 weeks)
   - Goal seeking and obstacle avoidance

**ASSIGNMENTS**

Unless otherwise stated by the section instructor, late assignments will not be accepted.

**COURSE POLICIES**

**Attendance Policy:**

*Excused Absences:* Absence for participation in recognized university activities, properly certified personal illness, or recognized emergencies may be excused by the Dean's office. Please note that the College of Engineering has a restrictive interpretation of what is considered a valid excuse for an absence. If an absence is to be excused, make sure you check beforehand. In case of excused absence, the instructor will work with you to help you make up for missed time and catch up.

*Unexcused Absences:* A student having more than four unexcused absences will be dropped from the course and assigned the grade F. No exceptions. Tests and exams missed because of unexcused absence receive the grade 0. No exceptions.

Other projects and activities missed completely receive the grade 0 for those projects or activities. No exceptions.

**Other Regulations:**

The Department’s Policy is clearly outlined at the following web location:

http://www.eng.fsu.edu/me/ugradpro/classes/policy/index.html

It is highly recommended that you read it carefully. Ignorance is not an excuse. Note that the penalties for copying work may result in a failing grade for the course. If you are uncertain, please check with the instructor who assigned the work. Working together is encouraged in this course, but blatant copying is not.
College of Engineering Undergraduate Policy:
As current policy, the College does not use plus +, or minus – grades in engineering courses (p. 4 COE Handbook http://www.eng.fsu.edu/documents/handbook1.pdf). A student may continue in the B.S. degree program unless one or more of the following conditions arise (p. 5 of COE Handbook):

a. A grade below C in the second attempt of the same engineering course
b. More than three (3) repeat attempts in engineering courses.
c. Violation of academic honor code as defined in university bulletin or catalog
d. Use of grade forgiveness (currently available for FAMU students only) in more than two (2) courses.

DEPARTMENTAL LEARNING OUTCOMES

The department's learning outcomes can be found at http://www.eng.fsu.edu/outcomes.

ACADEMIC HONOR CODE

Students are expected to uphold the Student Code of Conduct, Academic Honor Code published in their University Bulletin and/or Student Handbook.

The Florida State University Academic Honor Policy outlines the University’s expectations for the integrity of students’ academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to “. . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University.” (Florida State University Academic Honor Policy, found at http://www.fsu.edu/~dof/forms/honorpolicy.pdf.)

AMERICANS WITH DISABILITIES ACT

Students with disabilities needing academic accommodation should: (1) register with and provide documentation to the Student Disability Resource Center; (2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

For more information about services available to FAMU students with disabilities, contact the Office of Special Programs
Student Union #101
599-3541, FAX 561-2169
http://www.famu.edu/students/services/services.html

For more information about services available to FSU students with disabilities, contact the:
Student Disability Resource Center
97 Woodward Avenue, South
108 Student Services Building
Florida State University
Tallahassee, FL 32306-4167
(850) 644-9566 (voice), (850) 644-8504 (TDD)
sdrc@admin.fsu.edu
http://www.disabilitycenter.fsu.edu/
(This syllabus and other class materials are available in alternative format upon request.)
SYLLABUS CHANGE POLICY

This syllabus is a guide for the course and is subject to change without advanced notice.

Level of computer usage:  None  Elementary  Intermediate  Advanced

Modes of Instruction:  Lecture  Lab  DIS  Discussion  Other

Core Curriculum Course:  Yes  No

Availability to other Majors:  Yes  No

Note: We strongly encourage you to discuss questions or concerns with the course instructors during their office hours or by email.