**ENG ME 570 Robot Motion Planning**

**2008-2009 Catalog Data:**
**ENG ME 570 Robot Motion Planning** Prereq: ENG EK 102 or CAS MA 142 and CAS MA 226. Provides an overview of state-of-the-art techniques for robot motion planning. The emphasis is on the algorithms. It covers topology of configuration spaces, potential functions, roadmaps, cell decompositions, sampling-based algorithms, and model checking approaches to robot motion planning and control. 4 cr.

**Class/Lab Schedule:** Two 2 hour classes per week

**Status in the Curriculum:** Elective

**Textbook(s) and/or Other Required Material**: Choset, Lynch, Hutchison, Kantor, Burgard, Kavraki, Thrun, "Principles of robot motion: theory, algorithms and implementation", MIT Press, 2005

**Coordinator:** Calin Belta, Assistant Professor, Mechanical Engineering

**Prerequisites by topic:**
1. There are no specific prerequisites for this course. We provide the necessary mathematical background in class. However, a certain level of mathematical maturity is necessary, such as familiarity with linear algebra at the level of EK 102 and differential equations at the level of CAS MA 226.

**Goals:**
1. Introduce the students to mathematical formulations of robot configuration spaces
2. Teach the students various algorithms for motion planning and introduce them to complexity issues
3. Introduce the students to new area of symbolic motion planning
4. Together with AM 740, this class will provide a comprehensive introduction to robot planning and control. While AM740 focuses on control and complexity of robot dynamics, this new classes focuses on planning problem, environment complexity, and algorithms.

**Course Learning Outcomes:**
As an outcome of completing this course, students will:

i. Understand concepts underlying parameterizations of robot configuration spaces
ii. Know the principles of algorithm design for robot planning
iii. Understand the complexity of planning algorithms and be able to choose among them
iv. Be able to understand the connection between planning and control
v. Be able to use of use off-the-shelf software packages for motion planning and control

**Course Learning Outcomes mapped to Program Outcomes:**

| **Program**: | a | b | c | d | e | f | g | h | i | j | k | l | m | n |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course**: | i-iv | v | | | iii-v | | | | i-iv | | i-iv | | | i-iv |
| **Emphasis**: | 5 | 2 | 1 | 1 | 4 | 1 | 1 | 1 | 4 | 1 | 4 | 1 | 1 | 3 |

**Topics (time spent in weeks):**
1. Introduction and motivation (1)
2. Configuration space (2)
3. Potential functions (3)
4. Roadmaps (2)
5. Cell decompositions (2)
6. Sampling-based algorithms (2)
7. Model checking approaches to robot planning and control (2)

**Contribution of Course to Meeting the Professional Component:**
Engineering topics: 100%

**Status of Continuous Improvement Review of this Course:**
**Prepared by**: Calin Belta **Date**: 03/20/2009