1. **Number and title of course:** EECS-C125, Introduction to Robotics.
2. **Catalog description:** (4 units) An introduction to the kinematics, dynamics and control of robot manipulators, robotic vision, and sensing. The course will cover forward and inverse kinematics of serial chain manipulators, the manipulator Jacobian, force relations, dynamics, and position/force sensing. Network modeling, stability, and fidelity in teleoperation. Medical applications of robotics.
3. **Prerequisites:** EECS 120 or equivalent, consent of instructor.
4. **Textbooks and/or other required material:**

   - Murray, R. M., Li, Z., and Sastry, S. S.: *A Mathematical Introduction to Robotic Manipulation*, CRC Press, 1994

   Additional Reading:

   - Sciavicco, L. and Siciliano, B.: *Modelling and Control of Robot Manipulators*, Springer, 2001
   - Craig, J. J.: *Introduction to Robotics: Mechanics and Control*, Prentice Hall, 2003
   - Yoshikawa, T.: *Foundations of Robotics: Analysis and Control*, MIT Press, 1990
5. **Course objectives:** The goal of this course is to provide a unified introduction to the area of robotics for advanced undergraduates and beginning graduate students. This course provides a broad exposure to the subject. For students interested in further work in robotics, this course provides a useful introduction to more specialized graduate courses, CS 280 (Computer Vision) and CS 287 (Advanced Robotics).
6. **Topics covered:**

   Lecture 0: Robotics, its origin and evolution
   Lecture 1: General principles of rigid body motion
   Lecture 2: Rotation matrices and their properties
   Lecture 3: Rigid motion, Homogeneous coordinates
   Lecture 4: Geometry of cameras and their motion
   Lecture 5: Stereo reconstruction from two views
   Lecture 6: Exponential coordinates
   Lecture 7: Forces and Wrenches
   Lecture 8: Review before midterm
   Lecture 9: Midterm 1
   Lecture 10: Forward kinematics
   Lecture 11: Inverse kinematics
   Lecture 12: Inverse kinematics (cont.)
   Lecture 13: Jacobian of manipulator
   Lecture 14: Jacobian and differential inverse kinematics
   Lecture 15: Vision based robotics
   Lecture 16: Review before midterm
   Lecture 17: Midterm 2
   Lecture 18: Gyros, Accelerometers
   Lecture 19: Applications of body sensors
   Lecture 20: Force/Torque sensors
   Lecture 21: Range computation
   Lecture 22: Robot dynamics, Lagrange equations
   Lecture 23: Dynamics, Examples of simple robots
   Lecture 24: Dynamics (cont.)
   Lecture 25: Elementary feedback control

Lecture 26: Miscellaneous applications of robotic systems
Lecture 27: Project presentations

7. **Class/laboratory schedule**: Three hours of lecture and one hour of recitation per week.
8. **Contribution of course meeting the professional component:** This course covers engineering topics. It is approximately 80% science and 20% design.
9. **Relationship of course to program outcomes:** This course requires students to use their fundamental knowledge of mathematics, science, and engineering to configure, apply test conditions, and evaluate outcomes of experimental systems. Laboratory and homework assignments require students to design solutions to robotic kinematics problems. Through laboratory projects, students gain the ability to analyze and interpret data, and to function in teams and communicate their understanding. They learn to apply modern skills, techniques, and engineering tools. Emerging applications are covered throughout the course, giving students a knowledge of contemporary issues and an appreciation for the importance of life-long learning. Through discussions of the role of robotic applications in society, students learn about the impact of engineering solutions in society and their own ethical responsibility.
10. **Prepared by:** Ruzena Bajcsy (8/2008)