ECE4560 Course Syllabus

ECE4560

Introduction to Automation and Robotics (3-0-3-4)

CMPE Degree
This course is Elective for the CMPE degree.

EE Degree
This course is Elective for the EE degree.

Lab Hours
0 supervised lab hours and 3 unsupervised lab hours

Course Coordinator
Zhang,Ying

Prerequisites
ECE 3084 or 3550

Corequisites
None

Catalog Description
Fundamental disciplines of modern robotics: mechanics, control, and computing. Analysis, design, and control of mobile robots and manipulators. Course may contain team projects and hands-on labs.

Textbook(s)
Craig, *Introduction to Robotics, Mechanics and Control* (3rd edition), Prentice Hall, 2003. ISBN 9780201543612(optional)

Mark Spong, Seth Hutchinson, M. Vidyasagar, *Robot Modeling and Control*, 2005. (optional)

Peter Corke, *Robotics, Vision and Control: Fundamental Algorithms In MATLAB* (Second edition), 2017.(optional)

R Siegwart, INourbakhsh, and D Scaramuzza, *Introduction to Autonomous Mobile Robots* (Second edition), 2011.(optional)

Course Outcomes
Upon successful completion of this course, students should be able to:

1. Describe the dynamics of robots using mathematical formulation.
2. Design feedback control laws for robot motion stability and accurate tracking.
3. Develop software programs to generate motion plans for robots to achieve design goals.
4. Develop algorithms to process sensor data collected by robots.
5. Use open-source robotic software packages to design missions.

Student Outcomes

In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this outcome.

1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. (M) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. (LN) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. (LN) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (LN) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

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* Designing for Automation and Concurrent Engineering Principles (2
- Hard vs. Flexible Automation
- Basis Concepts in Concurrent Engineering
- Team Projects
* Anatomy of a Robot (1 week)
- Classification of Robots
- Robot Configurations
- Robot Components
- Performance Characteristics
* Object Location (1 week)
- Cartesian Coordinates
- Joint Coordinates
- Coordinate Transformations
* Manipulator Kinematics (2 weeks)
- Direct and Inverse Kinematics
- Solving the Arm Equation
- Examples
* Differential Motion (1 week)
- The Manipulator Jacobian
* Manipulator Dynamics (2 weeks)
- Lagrange-Euler Equations
- Other Formulations
- Software Tools and Examples
* Task Planning (1 week)
- Workspace Analysis
- Trajectory Planning
* Robot Control (2 weeks)
- Position/Torque Control
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- Advanced Control Methods
* Sensors and Sensing Strategies (1 week)
- Vision, force/torque and proximity sensors
* Applications (1 week)
* Intelligent Robotic Systems (1 week)
- Autonomous Robots