ECE 3161: Introduction to Robotics

Credits and contact hours: 3 Credits (Two 75-minute lectures per week)

Instructor: Shalabh Gupta

Textbook: *Robot Modeling and Control*, M. W. Spong, S. Hutchinson, M. Vidyasagar, John Wiley & Sons, 2006.

a. *Other supplemental materials* : Lecture notes, Project reports from previous years, Relevant journal and conference papers for reading

***Specific course information*:**

a. *Catalog Description*: Robot classification and multidisciplinary applications. Coordinate frames and kinematics. Sensing systems for obstacle avoidance, localization, and environment mapping. Motion path planning including shortest path planning and coverage path planning methods. Decision-making using neural networks. Course includes project work.

b. *Prerequisite*: MATH 2210; ECE 3101 or ME 3253

c. *Required, elective, or selected elective:* Elective

***Specific goals for the course*:**

a. *Specific outcomes of instruction*: Students will be able to apply the concepts of robot kinematics, motion planning, and sensing to design, construct and test real-robots that could be used for industrial as well as household activities.

b. *ABET Criterion 3 Student Outcomes addressed by the course*:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
Students learn to apply the concepts of robot kinematics, motion planning and sensing to the design and testing of real-robots that could be used for industrial as well as household activities

(2) 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
n/a

(3) an ability to communicate effectively with a range of audiences
The students make final project presentations in front of the class.

(4) 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

n/a

(5) 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
Students participate in semester-long projects as teams where they design, construct and test real-robots through experiments for meeting different performance metrics depending on the robot tasks.

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
Students participate in semester-long projects where they design, construct and test real-robots through experiments and data interpretation.

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
The course discusses the general applicability of robotic systems in various engineering domains and emerging technologies. The acquired physical understanding of robotic systems opens the way for long-term learning strategies.

Topics covered:

- Robot Classification and Multidisciplinary Applications
- Coordinate Frames
- Modeling Rigid Motions: *Rotational Transformations, Homogeneous Transformations*
- Forward and Inverse kinematics
- Sensing Systems: Obstacle Avoidance, Localization Methods
- Path Planning: *Shortest Path Planning, Coverage Path Planning*
- Decision-making using Neural Networks