ELECTRICAL, COMPUTER, AND SYSTEMS ENGINEERING DEPARTMENT

ABET COURSE SYLLABUS

ECSE-4490 Fundamentals of Robotics

Course Catalog Description: A survey of the fundamental issues necessary for the design, analysis, control, and implementation of robotic systems. The mathematical description of robot manipulators in terms of kinematics and dynamics. Hardware components of a typical robot arm. Path following, control, and sensing. Examples of several currently available manipulators. Fall term annually. *3 credit hours* .

Pre-Requisite Courses: ECSE-2410 Signals and Systems

Co-Requisite Courses: None

Prerequisites by Topic:

1. Matrix algebra
2. Vector analysis
3. Basic rotational dynamics: moments of inertia, torques, centrifugal, Coriolis
4. LaPlace transforms

Textbook: (and/or other required material) R.J. Schilling, *Fundamentals of Robotics*, Prentice Hall, 1990.

References: Class notes.

Course Coordinator: Alan A. Desrochers

Overall Educational Objective: To understand the problems of manipulation through modeling and then to control the robot motion to accomplish a desired task.

Course Learning Outcomes:

1. Be able to assign coordinate frames to describe the mechanical structure of a robot.
2. Be able to find the kinematic model of a robot from the coordinate frame assignment.
3. Be able to solve the inverse kinematics problem for purposes of positioning the tool tip at a desired location.
4. Be able to obtain the dynamic model of a robot arm.
5. Be able to design a controller so the arm can accomplish a specific task.

How Course Outcomes are Assessed:

Exam I	25%
Exam II	25%
Final Exam	35%
Homework	15%

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Relation to EE/CSE/EPE Outcomes

N = none
M = moderate
H = high

Outcome	Level	Demonstrate Proficiency
	N, M, H	e.g. Exams, projects, HW
Mathematics, science and engineering	H	Exams, HW
Basic disciplines in Electrical Engineering	M	Exams, HW
Depth in Electrical Engineering	H	Exams, HW
Basic disciplines in Computer & Sys. Eng.	M	Exams, HW
Depth in Computer and Systems Eng.	H	Exams, HW
Electromagnetics, electromechanics, power semiconductors	N	
Power system behavior	N	
Electrical energy conversion	N	
Conduct experiments and interpret data	M	Laboratory experiments

Identify, formulate and solve problems	M	Exams, HW
Design a system, component or process	N	
Communicate in written and oral form	N	
Function as part of a multi-disciplinary team	N	
Preparation for life-long learning	N	
Ethical issues; safety, health, public welfare	N	
Humanities and social sciences	N	
Laboratory equipment and software tools	M	Laboratory quiz
Variety of instruction formats	N	

Topics Covered:
(number of hours or classes for each)

1. Basic Robot Engineering Problems (3 classes)
2. Coordinate Transformations (2 classes)
3. Link Coordinates (2 classes)
4. Kinematics and Inverse Kinematics (4 classes)
5. Trajectory Planning (2 classes)
6. Jacobians (3 classes)
7. Manipulator Dynamics (3 classes)
8. Manipulator Control (6 classes)

Computer Usage: *Robotics Toolbox* for MATLAB

Laboratory Experiences:

1. Students have the option to program two industrial robots in the Advanced Manufacturing Laboratory at Rensselaer.

Design Experiences:

1. Design of manipulator control systems.

Independent Learning Experiences: None

Class/Lab Schedule: Two 80 minute classes/week. One week of optional lab.

Contribution to the Professional Component:

(a) College-level mathematics and basic sciences:	1 credit hour
(b) Engineering Topics (Science and/or Design):	2 credit hours
(c) General Education:	0 credit hours

Prepared by:	Alan A. Desrochers
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