Department of Mechanical Engineering

ME431– Introduction to Robotics and Automation

Elective

Catalog Description: ME 431 (3-0-3)

Introduction to mechanics and control of robotic manipulators. Topics include spatial transformations, kinematics, dynamics, trajectory generation, actuators and control, and relations to product design and flexible automation.

Prerequisites: Mech 236 – Dynamics
CIS 101 –Computer Programming and Problem Solving

Textbook(s) Materials Required:
John J. Craig, Introduction to Robotics: Mechanics and Control, 3rd Ed., Prentice-Hall, 2005.

Course Supervisor: Dr. Z. Ji

Pre-requisite by topic
1. Programming in a high-level language and its use in solving engineering problems
2. Motion of rigid bodies and kinematics of mechanisms
3. Dynamics

Course Objectives[1]:
1. To develop the student's knowledge in various robot structures and their workspace. (A, B, C)
2. To develop student's skills in performing spatial transformations associated with rigid body motions. (A, B, C)
3. To develop student's skills in perform kinematics analysis of robot systems.(A, B, C)
4. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems. (A, B, C)
5. To provide the student with some knowledge and analysis skills associated with trajectory planning. (A, B, C)
6. To provide the student with some knowledge and skills associated with robot control. (A, B, C)

Topics[2] :
1. Robot Structure and Workspace
2. Spatial Transformations
3. Orientation Matrices
4. Forward Kinematics
5. Inverse Kinematics
6. Jacobian and Singularities
7. Trajectory Generation
8. Robot Controller (hands-on project if the class enrollment is not too large)

Evaluation Method:

1. Exam
2. Homework
3. Project

Schedule: Lecture Recitation: 3 hours, per week

Professional Component: Engineering Science

Program Objectives Addressed: A, B, C

Course Outcomes[3]:

Objective 1

1.1 Students will demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics. (1,2,3) (a,e,k,m,n)

Objective 2

2.1. Students will demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators. (1,2,3) (a,e,k,m,n)

Objective 3

3.1. Students will demonstrate an ability to solve inverse kinematics of simple robot manipulators. (1,2) (a,e,k)

Objective 4

4.1. Students will demonstrate an ability to obtain the Jacobian matrix and use it to identify singularities. (1,2,3) (a,e,m,n)

Objective 5

5.1 Students will demonstrate an ability to generate joint trajectory for motion planning. (1,2,3) (a,k,n)

Objective 6

6.1 Students will demonstrate knowledge of robot controllers. (1,2,3) (k,n)

Prepared by: Z. Ji **Date: September 21, 2006**

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[1] Capital Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering
Department. Listed in Sec 2d Tables B-2-9, B-2-12. Table B-2-8 links Program Objectives with the ABET a-k Criterion.

[2] Topic numbers in parenthesis refer to lecture hours. (Three hours is equivalent to 1 week)

[3] Outcome numbers in parenthesis refer to evaluation methods used to assess the student performance. Lower case letters in parenthesis refer to ABET a-k outcomes.