COURSE OUTLINE

RAA106

Prepared: Juhani Paloniemi   Approved: Corey Meunier

Course Code: Title	RAA106: ROBOT MECHANICS
Program Number: Name	4068: ROBOTICS AUTOMATION
Department:	ROBOTICS GRADUATE CERTIFICATE
Semester/Term:	17F
Course Description:	The objective of this course is to introduce students to robot kinematics. The emphasis will be on the mathematical techniques used to relate the position and orientation of the end effector to the positions of the links and joints of the robot arm. The students will familiarize themselves with several common robot arm configurations and how their positions and motions are described. The students will be introduced to vector and matrix mathematics which form the basis of the techniques used.
Total Credits:	2
Hours/Week:	3
Total Hours:	45
This course is a pre-requisite for:	RAA200, RAA201, RAA203, RAA204
Vocational Learning Outcomes (VLO's): **Please refer to program web page for a complete listing of program outcomes where applicable.**	#1. Construct and evaluate robotic control programs for various scenarios against which to model the functionality and stability of automation systems. #5. Validate and optimize the functioning of motor, drive, control, and robotic systems.
Essential Employability Skills (EES):	#3. Execute mathematical operations accurately. #4. Apply a systematic approach to solve problems.
Course Evaluation:	Passing Grade: 50%, D
Evaluation Process and Grading System:	(see table below)

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Quizzes and/or Assignments	20%
Tests (4 evenly weighted)	80%

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Course Outcomes and Learning Objectives:

Course Outcome 1.

Explain the basic principles of robot kinematics

Learning Objectives 1.

o Describe forward kinematics
o Describe reverse kinematics

Course Outcome 2.

Define positions and orientations in 2-D and 3-D space

Learning Objectives 2.

o Use vectors to describe a point in 2-D space using Cartesian and polar coordinates
o Convert between Cartesian and polar coordinates in 2-D space
o Use vectors to describe a point in 3-D space using Cartesian, cylindrical and spherical coordinates
o Calculate the change in position of a point resulting from rotation of a vector
o Add vectors in 2-D and 3-D space
o Represent position vectors in matrix form
o Represent orientation of a vector in matrix form
o Explain what a frame is
o Map a point in one frame into another frame
o Map between translated and rotated frames
o Derive and solve transform equations

Course Outcome 3.

Mathematically describe the position and orientation of a given robot's end effector

Learning Objectives 3.

o Define link and joint

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o Describe base, station, wrist and tool frames
o Describe link frames in relation to each other and to the base frame

Course Outcome 4.

Describe inverse kinematics

Learning Objectives 4.

o Explain common challenges in inverse kinematics
o Describe limitations to the existence of solutions
o Explain multiple solutions

Course Outcome 5.

Describe force and velocity considerations of robot arms

Learning Objectives 5.

o Calculate the velocity of a point in relation to angular velocity of a link
o Describe torque in terms of force and link length

Date:	Friday, September 1, 2017
	Please refer to the course outline addendum on the Learning Management System for further information.