COURSE OUTLINE: RAA106 - ROBOT MECHANICS

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Course Code: Title	RAA106: ROBOT MECHANICS
Program Number: Name	4073: ROBOTICS & AUTOMATIO
Department:	ROBOTICS GRADUATE CERTIFICATE
Semesters/Terms:	21F
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:	2
Total Hours:	30
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
This course is a pre-requisite for:	RAA200, RAA201, RAA203, RAA204, RAA210
Vocational Learning Outcomes (VLO's) addressed in this course: **Please refer to program web page for a complete listing of program outcomes where applicable.**	**4073 - ROBOTICS & AUTOMATIO** VLO 1 Construct and evaluate robotic control programs for various scenarios against which to model the functionality and stability of automation systems. VLO 5 Validate and optimize the functioning of motor, drive, control, and robotic systems.
Essential Employability Skills (EES) addressed in this course:	EES 3 Execute mathematical operations accurately. EES 4 Apply a systematic approach to solve problems.
Course Evaluation:	Passing Grade: 50%, D A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.
Other Course Evaluation & Assessment Requirements:	The student must achieve at least 50% on the Tests portion of the final grade to achieve an overall passing grade in the course. Grade Definition Grade Point Equivalent A+ 90 - 100% 4.00

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2021-2022 academic year.

A 80 - 89% 4.00
B 70 - 79% 3.00
C 60 - 69% 2.00
D (Fail)50 - 59% 1.00
F (Fail)49% and below 0.00
CR (Credit) Credit for diploma requirements has been awarded.
S Satisfactory achievement in field /clinical placement or non-graded subject area.
U Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR Grade not reported to Registrar`s office.
W Student has withdrawn from the course without academic penalty.

Course Outcomes and Learning Objectives:

Course Outcome 1	**Learning Objectives for Course Outcome 1**
Explain the basic principles of robot kinematics	1.1 Describe forward kinematics 1.2 Describe reverse kinematics
Course Outcome 2	**Learning Objectives for Course Outcome 2**
Define positions and orientations in 2-D and 3-D space	2.1 Use vectors to describe a point in 2-D space using Cartesian and polar coordinates 2.2 Convert between Cartesian and polar coordinates in 2-D space 2.3 Use vectors to describe a point in 3-D space using Cartesian, cylindrical and spherical coordinates 2.4 Calculate the change in position of a point resulting from rotation of a vector 2.5 Add vectors in 2-D and 3-D space 2.6 Represent position vectors in matrix form 2.7 Represent orientation of a vector in matrix form 2.7 Explain what a frame is 2.8 Map a point in one frame into another frame 2.9 Map between translated and rotated frames 2.10 Derive and solve transform equations
Course Outcome 3	**Learning Objectives for Course Outcome 3**
Mathematically describe the position and orientation of a given robot`s end effector	3.1 Define link and joint 3.2 Describe base, station, wrist and tool frames 3.3 Describe link frames in relation to each other and to the base frame
Course Outcome 4	**Learning Objectives for Course Outcome 4**
Describe inverse kinematics	4.1 Explain common challenges in inverse kinematics 4.2 Describe limitations to the existence of solutions 4.3 Explain the existence of multiple solutions 4.4 Solve inverse kinematic problems in 2-D and 3-D
Course Outcome 5	**Learning Objectives for Course Outcome 5**
Describe force and velocity considerations of robot arms	5.1 Calculate the velocity of a point in relation to angular velocity of a link 5.2 Describe torque in terms of force and link length

Evaluation Process and

Grading System:	**Evaluation Type** / **Evaluation Weight** Quizzes and/or Assignments / 20% Tests / 80%
Date:	July 30, 2021
Addendum:	Please refer to the course outline addendum on the Learning Management System for further information.

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