



COURSE OUTLINE: RAA111 - RBT CELL DES,PER&SFT

Prepared: Donovan Kennedy

Approved: Corey Meunier, Chair, Technology and Skilled Trades

Course Code: Title	RAA111: ROBOT CELL DESIGN, PERIPHERALS & SAFETY
Program Number: Name	4073: ROBOTICS & AUTOMATIO
Department:	ROBOTICS GRADUATE CERTIFICATE
Academic Year:	2023-2024
Course Description:	This course deals with typical cell designs as well as best practices for safety and safety devices. A variety of hardware and software devices and applications will also be covered including end effectors, sensors, tool changers, dress packages and robotic welding. Practical aspects of the course will be explored using robotic simulation software.
Total Credits:	6
Hours/Week:	6
Total Hours:	84
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:	RAA201, RAA204
Vocational Learning Outcomes (VLO's) addressed in this course:	4073 - ROBOTICS & AUTOMATIO
Please refer to program web page for a complete listing of program outcomes where applicable.	VLO 1 Construct and evaluate robotic control programs for various scenarios against which to model the functionality and stability of automation systems.
	VLO 2 Plan and lead the installation of new industrial equipment and its physical and digital integration with existing systems.
	VLO 3 Collaborate with health and safety personnel to develop plans and specifications that incorporate, among other elements, safety controls and physical guarding to comply with all applicable regulatory safety designs and standards used in industrial robotic applications.
	VLO 6 Integrate budgetary, technical, functional and safety considerations in the design and optimization of custom automation solutions.
Essential Employability Skills (EES) addressed in this course:	EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.
	EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication.
	EES 4 Apply a systematic approach to solve problems.
	EES 5 Use a variety of thinking skills to anticipate and solve problems.
	EES 6 Locate, select, organize, and document information using appropriate technology and information systems.
	EES 7 Analyze, evaluate, and apply relevant information from a variety of sources.



	<p>EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.</p> <p>EES 10 Manage the use of time and other resources to complete projects.</p> <p>EES 11 Take responsibility for ones own actions, decisions, and consequences.</p>				
Course Evaluation:	<p>Passing Grade: 50%, D</p> <p>A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.</p>				
Other Course Evaluation & Assessment Requirements:	<p>Grade</p> <p>Definition Grade Point Equivalent</p> <p>A+ 90 - 100% 4.00</p> <p>A 80 - 89%</p> <p>B 70 - 79% 3.00</p> <p>C 60 - 69% 2.00</p> <p>D 50 - 59% 1.00</p> <p>F (Fail)49% and below 0.00</p> <p>CR (Credit) Credit for diploma requirements has been awarded.</p> <p>S Satisfactory achievement in field /clinical placement or non-graded subject area.</p> <p>U Unsatisfactory achievement in field/clinical placement or non-graded subject area.</p> <p>X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.</p> <p>NR Grade not reported to Registrar`s office.</p> <p>W Student has withdrawn from the course without academic penalty.</p> <p>Students must pass both the theory portion and the lab portion of the course including the practical exam to receive a passing grade in the course.</p> <p>Smart watches, smart phones and similar devices are not allowed during exams or quizzes and must be removed. Smart phones are not acceptable for use as a calculator during exams or quizzes.</p>				
Books and Required Resources:	<p>CSA-Z434-14 - Industrial Robots and Robot Systems</p> <p>Publisher: CSA Group Edition: R2019</p> <p>ISBN: 978-1-77139-330-0</p> <p>Available through the library</p>				
Course Outcomes and Learning Objectives:	<table border="1"> <thead> <tr> <th>Course Outcome 1</th> <th>Learning Objectives for Course Outcome 1</th> </tr> </thead> <tbody> <tr> <td>1. Understand standard safeguarding and safety devices used in automated cells.</td> <td> 1.1 Investigate safety practices and standards as they relate to manufacturing cells. 1.2 Identify and demonstrate elements of an automation cell that require safeguarding and applications of safety devices. 1.3 Examine different safety devices such as light curtains, area scanners and emergency stop interfaces. 1.4 Examine different safety Fieldbus protocols used in industry. 1.5 Contrast and compare safety devices used in the robotics </td> </tr> </tbody> </table>	Course Outcome 1	Learning Objectives for Course Outcome 1	1. Understand standard safeguarding and safety devices used in automated cells.	1.1 Investigate safety practices and standards as they relate to manufacturing cells. 1.2 Identify and demonstrate elements of an automation cell that require safeguarding and applications of safety devices. 1.3 Examine different safety devices such as light curtains, area scanners and emergency stop interfaces. 1.4 Examine different safety Fieldbus protocols used in industry. 1.5 Contrast and compare safety devices used in the robotics
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	lab at Sault College. 1.6 Understand hazardous energy, risk assessments and fail-safe design.
Course Outcome 2	Learning Objectives for Course Outcome 2
2. Understand manufacturing cell design.	2.1 Differentiate the key concepts of manual vs. automated assembly systems. 2.2 Investigate and demonstrate concepts of robot work envelopes and cycle time as they pertain to automated cells and robots. 2.3 Examine various cell design tools.
Course Outcome 3	Learning Objectives for Course Outcome 3
3. Understand different types of robot reach limitation as it pertains to safety in robot cells.	3.1 Examine soft limit robot reach, world zones, safe operation software. 3.2 Examine hard limit robot reach. 3.3 Examine software applications that prevent robot incursions.
Course Outcome 4	Learning Objectives for Course Outcome 4
4. Understand various types of end effectors used in robotic applications.	4.1 Discuss the types of movements an end effector can perform. 4.2 Describe the types of end effector grippers. 4.3 Identify the benefits of end effector grippers. 4.4 List important factors and desirable characteristics to be considered in the selection of grippers for different applications. 4.5 Investigate the use and application of vacuum grippers. 4.6 Investigate the use and application of parallel grippers. 4.7 Investigate the use and application of servo grippers. 4.8 Understand dress package requirements and cable management used in robot applications. 4.9 Identify different end effector tools and their applications. 4.10 Describe the common types of end effector tools and their Applications. 4.11 List important factors and desirable characteristics to be considered in the design of end effector tools. 4.12 Identify different end effector Tools and their applications. 4.13 Describe what non-prehensile is in relation to end effector tools. 4.14 State examples of robot end effector tools used in automated industries. 4.15 List the advantages of end effector tools. 4.16 List the disadvantages of end effector tools.
Course Outcome 5	Learning Objectives for Course Outcome 5
5. Examine various types of end effector tool changers used in robotic applications.	5.1 Identify different end effector tool changers and their applications. 5.2 Identify the benefits of changeable end effectors. 5.3 List important factors and desirable characteristics to be considered in the design of end effector tool changers. 5.4 State examples of robot end effector tool changers used in automated industries.

		5.5 List the advantages of end effector tool changers. 5.6 List the disadvantages of end effector tools changers.
	Course Outcome 6	Learning Objectives for Course Outcome 6
	6. Examine various types of sensors and their applications.	6.1 Investigate different sensor types used in automation. 6.2 Compare and contrast different sensors used in automation.
	Course Outcome 7	Learning Objectives for Course Outcome 7
	7. Understand the use of actuators, solenoids and encoders in industrial applications.	7.1 Discuss different types of encoders (incremental, absolute). 7.2 Discuss how encoders are used for tracking parts in automation cells. 7.3 Explore robot tracking software and how it uses encoders. 7.4 Discuss how actuators are used in automation cells. 7.5 Discuss how solenoids are used in peripheral devices.

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Assignments & Labs	30%
Lab Practical Exam	20%
Participation	10%
Written Exam 1	20%
Written Exam 2	20%

Date: May 30, 2023

Addendum: Please refer to the course outline addendum on the Learning Management System for further information.