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

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Course Code: Title	RAA111: ROBOT CELL DESIGN, PERIPHERALS & SAFETY
Program Number: Name	4073: ROBOTICS & AUTOMATIO
Department:	ROBOTICS GRADUATE CERTIFICATE
Semesters/Terms:	21F
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.
Total Credits:	6
Hours/Week:	6
Total Hours:	90
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: **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 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.

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.

	EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals. EES 10 Manage the use of time and other resources to complete projects. EES 11 Take responsibility for ones own actions, decisions, and consequences.
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:	Grade Definition Grade Point Equivalent A+ 90 - 100% 4.00 A 80 - 89% B 70 - 79% 3.00 C 60 - 69% 2.00 D 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. Students must pass both the theory portion and the lab portion of the course including the practical test to receive a passing grade in the course. Smart watches, smart phones and similar devices are not allowed during tests or quizzes and must be removed. Smart phones are not acceptable for use as a calculator during a test or quiz.
Books and Required Resources:	Production Systems, and Computer-Integrated Manufacturing by Mikell P. Groover Publisher: Pearson Edition: Fifth ISBN: 978-0-13-460546-3

Course Outcomes and Learning Objectives:

Course Outcome 1	**Learning Objectives for Course Outcome 1**
1. Examine 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 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 lab at Sault College.
Course Outcome 2	**Learning Objectives for Course Outcome 2**

2. Investigate manufacturing cell design.	2.1 Differentiate the key concepts of manual vs. automated assembly systems. 2.2 Investigate concepts of reach study and cycle rate as they pertain to automated cells and robots.
Course Outcome 3	**Learning Objectives for Course Outcome 3**
3. Investigate WMS and larger manufacturing cells.	3.1 Investigate the design of warehouse management systems. 3.2 Examine principles of material handling. 3.3 Analyze material transport systems.
Course Outcome 4	**Learning Objectives for Course Outcome 4**
4. Practice different types of robot reach limitation as it pertains to safety in robot cells.	4.1 Examine soft limit robot reach, world zones, safe operation software. 4.2 Examine hard limit robot reach. 4.3 Examine software applications that prevent robot incursions.
Course Outcome 5	**Learning Objectives for Course Outcome 5**
5. Examine various types of end effectors used in robotic applications.	5.1 Discuss the types of movements an end effector can perform. 5.2 Describe the types of end effector grippers. 5.3 Identify the benefits of end effector grippers. 5.4 List important factors and desirable characteristics to be considered in the selection of grippers for different applications. 5.5 Investigate the use and application of vacuum grippers. 5.6 Investigate the use and application of parallel grippers. 5.7 Investigate the use and application of servo grippers. 5.8 Examine dress package requirements and cable management used in robot applications. 5.9 Identify different end effector tools and their applications. 5.10 Describe the common types of end effector tools and their Applications. 5.11 List important factors and desirable characteristics to be considered in the design of end effector tools. 5.12 Identify different end effector Tools and their applications. 5.13 Describe what non-prehensile is in relation to end effector tools. 5.14 State examples of robot end effector tools used in automated industries. 5.15 List the advantages of end effector tools. 5.16 List the disadvantages of end effector tools.
Course Outcome 6	**Learning Objectives for Course Outcome 6**
6. Examine various types of end effector changers used in robotic applications.	6.1 Identify different end effector tool changers and their applications. 6.2 Identify the benefits of changeable end effectors. 6.3 List important factors and desirable characteristics to be considered in the design of end effector tool changers. 6.4 State examples of robot end effector tool changers used in automated industries. 6.5 List the advantages of end effector tool changers. 6.6 List the disadvantages of end effector tools changers.

Course Outcome 7	Learning Objectives for Course Outcome 7
7. Examine various types of sensors and their applications.	7.1 Investigate different sensor types used in automation. 7.2 Compare and contrast different sensors (photoelectric, diffuse, ultrasonic, etc...).
Course Outcome 8	**Learning Objectives for Course Outcome 8**
8. Examine the use of actuators, solenoids and encoders in industrial applications.	8.1 Illustrate different types of encoders (incremental, absolute). 8.2 Investigate how encoders are used for tracking parts in automation cells. 8.3 Examine robot tracking software and how it uses encoders. 8.4 Investigate how actuators are used in automation cells. 8.5 Investigate how solenoids are used in peripheral devices.

Evaluation Process and Grading System:

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

Date: July 30, 2021

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