COURSE OUTLINE: RAA205 - AUTOMATION NETWORKIN

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Course Code: Title	RAA205: INDUSTRIAL AUTOMATION NETWORKING I
Program Number: Name	4026: ELECTRICAL TN-PROC 4073: ROBOTICS & AUTOMATIO 4127: ELECTRICAL TN-TRADES
Department:	ROBOTICS GRADUATE CERTIFICATE
Academic Year:	2024-2025
Course Description:	The student will study the technology and protocols used in industrial networks for process automation. Ethernet, the TCP/IP 4 layer model and the OSI 7 layer model will form the basis of the course. The theory will be strengthened with hands-on labs in cable making, protocol and signal analysis as well as building simple client/server networks. The industrial networks Ethernet/IP and DeviceNet/CANBUS will also be studied.
Total Credits:	4
Hours/Week:	4
Total Hours:	56
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
Substitutes:	ELR251
Vocational Learning Outcomes (VLO's) addressed in this course: **Please refer to program web page for a complete listing of program outcomes where applicable.**	**4026 - ELECTRICAL TN-PROC** VLO 6 Verify acceptable functionality and apply troubleshooting techniques for electrical and electronic circuits, components, equipment, and systems under the supervision of a qualified person. VLO 8 Use computer skills and tools to solve routine electrical related problems. VLO 11 Install, test and troubleshoot telecommunication systems under the supervision of a qualified person. **4073 - ROBOTICS & AUTOMATIO** VLO 2 Plan and lead the installation of new industrial equipment and its physical and digital integration with existing systems. VLO 7 Formulate and use a variety of troubleshooting techniques on new and legacy electromechanical equipment, processes, systems and subsystems. **4127 - ELECTRICAL TN-TRADES** VLO 6 Verify acceptable functionality and apply troubleshooting techniques for electrical and electronic circuits, components, equipment, and systems under the supervision of a qualified person.

	VLO 8	Use computer skills and tools to solve routine electrical related problems.
	VLO 11	Install, test and troubleshoot telecommunication systems under the supervision of a qualified person.
Essential Employability Skills (EES) addressed in this course:	EES 3	Execute mathematical operations accurately.
	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.
	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.

The student must pass both the theory portion and the lab portion to pass 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:

Data Communications and Networking by Behrouz Forouzan
Publisher: McGraw-Hill Edition: Fourth
ISBN: 9780073250328
Free Access Provided by McGraw-Hill`s Access Engineering via Sault College Library

Course Outcomes and Learning Objectives:

Course Outcome 1	Learning Objectives for Course Outcome 1
1. Describe telecommunication networks in general and utilize telecommunications/networking terminology.	1.1 List and describe the elements common to all telecommunication networks. 1.2 Define a network and their various configurations. 1.3 Compare and contrast various types of networks including client/server, peer to peer. 1.4 Identify and describe physical network topologies and associated media access control methods (logical topology). 1.5 Identify and describe simplex versus full/half duplex communication and multi-access vs. point-to-point links.
Course Outcome 2	**Learning Objectives for Course Outcome 2**
2. Identify various telecommunication standards, organizations, and network models.	2.1 List and describe the 7 layers of the OSI model, the 4 layers of the TCP/IP model and discuss commonalities and differences between the two. 2.2 Identify various protocols at each layer of the models and describe its purpose. 2.3 Identify the method of addressing at various layers and the associated protocol data units. 2.4 Identify standards organizations and the relevant telecommunication standards maintained by the organization.
Course Outcome 3	**Learning Objectives for Course Outcome 3**
3. Analyze the various methods of transmitting data at the physical Layer.	3.1 List and describe various devices that operate at the physical layer including repeaters, hubs, transceivers. 3.2 List and describe various methods for encoding data into electrical signals, identify potential electrical impairments, various modulation methods, and channel capacity. 3.3 Describe the EIA/TIA RS232C standard, operation at the physical layer, and the relevant settings and their function/purpose which are associated with the RS232C communication standard. 3.4 Prepare cables and connections to utilize the RS232C standard, exchange data between various networked devices and capture electrical signals (data) transmitted using the standard. 3.5 Analyze RS232 signalling by converting between binary and electrical representation of data. 3.6 Identify fiber optic media types, capabilities, connectors, configurations, and describe their advantages/disadvantages. 3.7 Identify copper media types, capabilities, connectors, configurations, and describe their advantages/disadvantages. 3.8 Prepare and test copper cables and connections utilizing the Ethernet standard.
Course Outcome 4	**Learning Objectives for Course Outcome 4**
4. Describe the operation of protocols and devices at the data link layer and explain how they support communications.	4.1 Explain the role of Data Link layer protocols in data transmission and how data is prepared for transmission on network media. 4.2 Describe the different types of media access control methods. 4.3 Explain the purpose of encapsulating packets into frames,

	protocol, the frame header and trailer fields, and physical addressing. 4.4 Describe the physical devices that operate at the data link layer including bridges, switches, and network interface cards. 4.5 Describe the address resolution protocol and how it is use to resolve a logical address (IP) to a physical address (MAC). 4.6 Utilize software to analyze Ethernet frames at the data link layer of the OSI model.
Course Outcome 5	**Learning Objectives for Course Outcome 5**
5. Describe the features, protocols and services at the Network layer protocols and explain the fundamental concepts of routing.	5.1 Identify the role of the network layer in end device to end device communication. 5.2 Examine the most common Network layer protocols the Internet Protocol (IP), and its features for providing connectionless, best-effort service. 5.3 Understand the principles used to guide the division, or grouping, of networkable devices into networks. 5.4 Understand the hierarchical logical addressing of devices and how this allows communication between networks with the implementation of routing. 5.5 Use and configure network equipment such as switches and routers to create LANs, VLANs, trunks, and routing to allo communication between devices utilizing networks.
Course Outcome 6	**Learning Objectives for Course Outcome 6**
6. Calculate and apply IP addressing and subnet masks to fulfill the given requirements of a network.	6.1 Understand and explain the IP address and subnet mask structures and demonstrate the ability to convert between 8-bi binary and decimal numbers. 6.2 Explain how addresses are assigned to networks by ISPs and within networks by administrators. 6.3 Determine the network and host portions of an IP address and explain the role of the subnet mask in dividing networks. 6.4 Identify classes of IPv4 addresses address by type and describe how they are used in the network. 6.5 Given IPv4 addressing information and design criteria, calculate the appropriate addressing components. 6.6 Use common testing and troubleshooting techniques to verify and test connectivity and operational status of devices using the IP protocol.
Course Outcome 7	**Learning Objectives for Course Outcome 7**
7. Describe the features of the transport layer protocols and services.	7.1 Explain the need for the transport layer and identify the rol of the transport layer as it pertains to the end-to-end transfer c data between applications. 7.2 Explain the key functions of the Transport layer, including reliability, port addressing, and segmentation. 7.3 Describe the role of two transport layer protocols common used with Ethernet IP networks, TCP and UDP. 7.4 Identify appropriate applications for the TCP and UDP protocols and provide examples of applications that use each protocol.
Course Outcome 8	**Learning Objectives for Course Outcome 8**

8. Describe and utilize various services provided by the application layer.	8.1 Describe how the functions of the three upper OSI model layers provide network services to end user applications. 8.2 Define how people interact with the application layer to communicate across telecommunication networks and the function of various, well-known TCP/IP applications, such as the World Wide Web and email. 8.2 Define how network devices interact with the application layer to communicate across telecommunication networks and provide services for network management. 8.4 Explain how protocols ensure services running on one kind of device can send to and receive data from many different network devices.
Course Outcome 9	**Learning Objectives for Course Outcome 9**
9. Describe and utilize secure communication services on networks.	9.1 Explain the concept of cryptography in the context of a communication network and the terminology associated with it 9.2 Describe goals of network security services and the services they aim to provide. 9.2 Describe the various types of ciphers, encryption, keys, and hashing used in secure communication. 9.3 Describe protocols used at the network layer to achieve network security goals. 9.4 Utilize software to securely communicate between two networked devices.
Course Outcome 10	**Learning Objectives for Course Outcome 10**
10. Describe, analyze, and utilize industrial network protocols, such as Ethernet/IP and DeviceNet (CANBUS), with intelligent automation devices.	10.1 Describe the differences between Ethernet/IP and Ethernet. 10.2 Describe and explain the components and organization of the Common Industrial Protocol (CIP). 10.3 Utilize software to extract process data from an intelligent automation device using the CIP data structure. 10.4 Establish communication between two networked intelligent automation devices for the purposes of automation. 10.5 Differentiate DeviceNet as the high level and CANBUS as the low level protocol. 10.6 Describe the physical and data link layer characteristics of DeviceNet and CANBUS. 10.7 Describe the signaling and arbitration capability of CANBUS and analyze CANBUS signaling to determine the results of arbitration.

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Assignments and Quizzes	10%
Labs	20%
Written Test #1	20%
Written Test #2	25%
Written Test #3	25%

Date:	August 9, 2024
Addendum:	Please refer to the course outline addendum on the Learning Management System for further information.