COURSE OUTLINE: RAA205 - AUTOMATION NETWORKIN

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Course Code: Title	RAA205: INDUSTRIAL AUTOMATION NETWORKING I
Program Number: Name	4026: ELECTRICAL TN-PROC 4068: ROBOTICS AUTOMATION
Department:	ROBOTICS GRADUATE CERTIFICATE
Semesters/Terms:	20W
Course Description:	The student will study the technology and protocols used in industrial networks for process automation. The TCP/IP 4 layer model will form the basis of the course with a comparison to the OSI 7 layer model. The theory will be strengthened with hands-on labs in cable making, protocol analysis (RS232, RS485, TCP/IP) as well as building simple client/server networks. Industrial networks topics such as Ethernet/IP, DeviceNET and CAN BUS will also be studied.
Total Credits:	4
Hours/Week:	4
Total Hours:	60
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 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 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.
Course Evaluation:	Passing Grade: 50%, D
Other Course Evaluation & Assessment Requirements:	To pass the course, the student must achieve a passing grade (50%) in both the theory and the lab part of this course. For example, it is not possible to pass the course if a student has a failing average in the three written tests but is passing the lab portion, (or vice versa). 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.

Course Outcomes and Learning Objectives:

Course Outcome 1	**Learning Objectives for Course Outcome 1**
1. Describe telecommunication networks in general and begin building a telecommunications vocabulary.	1.1 List and describe the elements common to all telecommunication networks. 1.2 Define a network 1.3 Define and distinguish LAN, WAN, CAN, MAN 1.4 Compare and contrast various types of networks including client/server, peer to peer. 1.5 Describe the term NOS network operating systems 1.6 Describe physical topologies (bus,ring,star), and associated media access control methods (logical topology) 1.7 Compare circuit switching and packet switching 1.8 Differentiate simplex, full/half duplex 1.9 Differentiate multi-access vs point-to-point links
Course Outcome 2	**Learning Objectives for Course Outcome 2**
2. Identify the various telecommunication standards organizations and their associated standards	2.1 List and describe the 7 layers of the OSI model and 2.2 Compare them to the 4 layers of the TCP/IP model 2.3 Identify various protocols at each layer and describe their purpose 2.4 Identify the method of addressing at various layers and the associated protocol data units 2.5 List the following standards organizations and identify the important telecommunication standards from each: ANSI, EIA/TIA, IEEE, ISO, ITU, ISOC, IANA AND ICANN
Course Outcome 3	**Learning Objectives for Course Outcome 3**
3. Analyze the various methods of transmitting data at the Physical Layer	3.1 Describe the EIA/TIA RS232C standard and capture and analyze a data transmitted using this standard 3.2 Construct a nul-modem connection between two devices 3.3 Exchange single character data between the devices and then exchange a file 3.4 Describe how parity can be used as a method for error detection 3.5 Identify fiber optic media types, capabilities and describe the various potential impairments 3.6 List and describe various methods for encoding data into electrical signals and identify potential electrical impairments 3.7 List and describe various modulation methods & telephone channel capacity 3.8 List and describe various devices that operate at the physical layer including repeaters, hubs, transceivers. 3.9 List the components of structured network cabling.

	3.10 Identify the various standards that apply to structured cabling 3.11 Describe the purpose of, identify and construct network patch cables including straight through, crossover and rollover 3.12 Compare and contrast Twisted Pair cabling vs Coaxial cabling regarding: construction, application, advantages/disadvantages for each
Course Outcome 4	**Learning Objectives for Course Outcome 4**
4. Describe the operation of protocols and devices at the OSI Data link layer and explain how they support communications	4.1 Explain the role of Data Link layer protocols in data transmission. 4.2 Describe how the Data Link layer prepares data for transmission on network media. 4.3 Describe the different types of media access control methods. 4.4 Identify the common logical network topologies and describe how the logical topology determines the media access control method for that network. 4.5 Explain the purpose of encapsulating packets into frames 4.6 Describe the Layer 2 frame structure and identify generic fields. 4.7 Explain the role of the frame header and trailer fields, including addressing, type of protocol, and Frame Check Sequence. 4.8 Describe the devices that operate at the data link layer including bridges, switches and the NIC. 4.9 Compare various industrial network standards (HART, CANBUS) and their characteristics at the 4.10 Data link layer 4.11 Describe how ARP is used to resolve an IP address to a MAC address 4.12 Utilize software such as Wireshark to analyze packets (and frames) at the lower 3 layers of the OSI model.
Course Outcome 5	**Learning Objectives for Course Outcome 5**
5. Describe the features of the Network layer protocols and services and explain the fundamental concepts of routing	5.1 Identify the role of the Network layer as it describes communication from one end device to another end device. 5.2 Examine the most common Network layer protocols the Internet Protocol (IP), and its features for providing connectionless and best-effort service 5.3 Understand the principles used to guide the division, or grouping, of devices into networks. 5.4 Understand the hierarchical addressing of devices and how this allows communication between networks. 5.5 Describe the fundamentals of routes, next-hop addresses, and packet forwarding to a destination network. 5.6 Utilize switches and TRUNK ports to build VLANs and use a router to carry traffic between them
Course Outcome 6	**Learning Objectives for Course Outcome 6**
6. Calculate, and apply subnet masks and IP addresses to fulfill given requirements	6.1 Explain the structure IP addressing and demonstrate the ability to convert between 8-bit binary and decimal numbers. 6.2 Given an IPv4 address, classify by type and describe how it is used in the network. 6.3 Explain how addresses are assigned to networks by ISPs and within networks by administrators.

	6.4 Determine the network portion of the host address and explain the role of the subnet mask in dividing networks. 6.5 Given IPv4 addressing information and design criteria, calculate the appropriate addressing components. 6.6 Use common testing utilities to verify and test connectivity and operational status of the IP protocol stack on a device.
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. 7.2 Identify the role of the Transport layer as it provides the end-to-end transfer of data between applications. 7.3 Describe the role of two TCP/IP Transport layer protocols: TCP and UDP. 7.4 Explain the key functions of the Transport layer, including reliability, port addressing, and segmentation. 7.5 Identify when it is appropriate to use TCP or UDP and provide examples of applications that use each protocol
Course Outcome 8	**Learning Objectives for Course Outcome 8**
8. Describe & utilize the Application Layer & its protocols.	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 use the Application Layer to communicate across the telecommunication network. 8.3 Describe the function of well-known TCP/IP applications, such as the World Wide Web and email, and their related services (HTTP, DNS, SMB, DHCP, SMTP, SNMP, and Telnet). 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 the nature of the Ethernet IP networking protocol.	9.1 Differentiate ETHERNET/IP from standard ETHERNET. 9.2 Describe the CIP Common Information Protocol 9.3 Analyze Ethernet/IP communications using Wireshark
Course Outcome 10	**Learning Objectives for Course Outcome 10**
10. Describe the nature of the DeviceNET and CANBUS networking protocols.	10.1 Differentiate DeviceNET as the high level and CANBUS as the low level protocol. 10.2 Describe the physical and Datalink layer characteristics of CANBUS. 10.3 Describe the signaling and arbitration capability of CANBUS.

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Assignments and Quizzes	40%
Tests	60%

Date: August 27, 2019

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