NIRMA UNIVERSITY

Institute:	**Institute of Technology, School of Technology**
Name of Programme:	**B Tech in Electronics and Instrumentation Engineering**
Semester:	**VII**
Course Code:	4EI201ME25
Course Title:	**Data Communication and Industrial Networking**
Course Type:	**Department Elective-IV**
Year of Introduction:	**2024-25**

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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. illustrate the concepts of communication model and Physical standards (BL2)
2. recognize the basics of various industrial networking standards (BL2)
3. compare the various industrial communication standards (BL5)
4. demonstrate the applications of communication protocols in the field of process automation. (BL6)

Unit	Contents	Teaching hours (Total 45)
Unit- I	**Introduction to Networks in Process Automation** Introduction to Open system interconnection (OSI) model and communication model for industries, network topology, media access methods, cables.	03
Unit- II	**Physical Standards** Introduction to RS-232, RS-485 standards, troubleshooting of the RS-232 and RS-485, RS-485 converters, IEEE 802 standard	05
Unit- III	**Modbus and Modbus plus Protocols** Overview of Modbus, transmission modes, data types, function codes and frame design, overview of Modbus transmission control protocol/internet protocol (Modbus TCP/IP), Modbus Plus, comparison of Modbus variants, introduction of tools, case studies.	07
Unit- IV	**Fieldbus** Fieldbus technology vs conventional communication methods, fieldbus devices, problems with fieldbus, wiring and installation practice with fieldbus, termination methods, troubleshooting of fieldbus system, case studies.	06
Unit- V	**Sensor and Device Level Protocols** Actuator sensor interface (AS-I), controller area network (CAN), highway addressable remote transducer (HART) protocol, case studies.	06
Unit- VI	**Foundation Fieldbus** Overview of foundation fieldbus, physical layer and wiring rules, error detection and diagnostics, case studies.	04

Unit- VII	**ProfiBus** Overview of profibus variants, protocol stack and communication model, system operation, troubleshooting, comparison and applications of various standards, case studies.	05
Unit- VIII	**OPC for Process Control** Overview of open platform communications (OPC), OPC architecture, OPC DA3.0 data access, OPC unified architecture (OPC UA), case studies.	03
Unit- IX	**Industrial Ethernet and IIOT** Industrial Ethernet, Overview of Industrial internet of things (IIOT), Message Queuing Telemetry transport (MQTT), Advanced message queuing protocol (AMQP), Representational state transfer (REST), The data hub transfer protocol (DHTP).	06

Self Study:

The self -study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Tutorial:

Tutorial work will be based on above syllabus with minimum 10 tutorials to be incorporated.

Suggested Readings:

1. John Park, Steve Mackay, Edwin Wright, *Practical Data Communications for Instrumentation and Control*, Elsevier Publication
2. A. Behrouz Forouzan, *Data Communications & Networking*, Tata McGraw-Hill Publication.
3. Deon Reynders, Steve Mackay, Edwin Wright, *Practical Industrial Data Communications: Best Practice Techniques*, Elsevier Publication.
4. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress
5. Giacomo Veneri, Antonio Capasso, *Hands-on Industrial Internet of Things*, Packt Publication

Suggested List of Tutorials:

Sr. No.	Name of Experiments/Exercises
1.	Review the current trends in industrial data communication
2.	Case study of Modbus, Modbus TCP/IP
3.	Case study of Fieldbus standard
4.	Case study of HART standard
5.	Case study of AS-I standard
6.	Case study of Controller Area Network
7.	Case study of Foundation fieldbus standard
8.	Case study of Profibus standard
9.	Prepare list of opensource softwares for industrial data communication and demonstrate anyone
10.	Case study of industrial internet of things