

# GUJARAT TECHNOLOGICAL UNIVERSITY

**POWER ELECTRONICS (24)**  
**INDUSTRIAL COMMUNICATION SYSTEM**  
**SUBJECT CODE: 2162410**  
**B.E. 6<sup>th</sup> SEMESTER**

**Type of course:** Engineering Science (Electrical)

**Prerequisite:** 1) 2130903 - Electrical Measurements and Measuring Instruments  
 2) 2142405 - Analog Electronics and its Applications  
 3) 21524xx – Industrial Instrumentation

**Rationale:** This subject focuses on the study of different methods of data communication between different control devices and field instruments, and the study of the protocols used for data communication.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	20	20	10	150

**Content :**

Sr. No.	Topic	Teaching Hrs.	Module Weightage %
<b>1</b>	<b>Basic of Communication System</b> <ul style="list-style-type: none"> <li>• Communication, Communication systems, Modulation, Bandwidth Requirement. Channel Capacity, Baud Rate, Data Rate.</li> </ul>	<b>02</b>	<b>5-10</b>
<b>2</b>	<b>Modulation:</b> <ul style="list-style-type: none"> <li>• Theory of Amplitude Modulation, Frequency spectrum of AM wave, Representation of AM, Power Relation in the AM wave.</li> <li>• Theory of Frequency Modulation, Mathematical Representation of FM, Frequency spectrum of FM wave.</li> <li>• Theory of Phase Modulation, Comparison of different modulations</li> <li>• Modulation for Digital signal: Introduction, modulation circuit, demodulation circuit, ASK, FSK, PSK, PWM, PAM, PPM.</li> </ul>	<b>10</b>	<b>15-25</b>
<b>3</b>	<b>Basic Principles of Data Communication</b> <ul style="list-style-type: none"> <li>• Bit, Bytes and Characters, Communication principle, Communication modes, Synchronous and asynchronous system, Error detection, Transmission Characteristics, Data coding, UART.</li> </ul>	<b>04</b>	<b>10-15</b>
<b>4</b>	<b>Serial Communication Standard</b> <ul style="list-style-type: none"> <li>• Serial data communication interface standards, Balanced and unbalanced transmission lines, RS 232 interface standard, Troubleshooting serial data communication circuits, Test equipment, RS 422 Standard, RS 485 Standard, Troubleshooting and testing with</li> </ul>	<b>10</b>	<b>15-25</b>

	RS 485, 20 mA Current loop, GPIB ,USB.		
<b>5</b>	<b>Cabling and Interference</b> <ul style="list-style-type: none"> <li>• Cabling: Introduction, Copper based cable, Coaxial cable, Twisted pair cable, Fiber optic cable.</li> <li>• <b>Noise and Interference</b> : Definition of noise, External and Internal noise, Noise calculation, Noise Figure, Noise Temperature, , Frequency analysis of noise, Source of electrical noise, Electrical coupling of noise, Shielding, Cable ducting, Cable spacing, Earthing and grounding requirement, Suppression techniques.</li> </ul>	<b>06</b>	<b>10-15</b>
<b>6</b>	<b>Industrial Protocols</b> <ul style="list-style-type: none"> <li>• Introduction to protocols</li> <li>• Modbus protocol</li> <li>• HART</li> <li>• Fieldbus and DeviceNet system</li> <li>• TCP / IP</li> </ul>	<b>12</b>	<b>20-25</b>
<b>7</b>	<b>LAN and Wireless Communication Systems</b> <ul style="list-style-type: none"> <li>• Overview of class of network, Network Topologies, Transmission Techniques, Ethernet.</li> <li>• Wireless LAN using CSMA/CA, Cellular Digital Packet Network, Satellite communication.</li> </ul>	<b>04</b>	<b>10-15</b>

**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
<b>30%</b>	<b>25%</b>	<b>25%</b>	<b>10%</b>	<b>10%</b>	<b>0</b>

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

- 1 Electronic Communication Systems, Kennedy and Devis
- 2 Practical Data Communications for Instrumentation and Control, John Park
- 3 Introduction to Data and Network Communication, Michael A. Miller
- 4 Instrument Engineers Handbook Vol. III, B.G.Liptak

**Course Outcome:**

After learning the course the students should be able to:

1. Explain various methods of data communication.
2. Explain various protocols used for data communication.

**Laboratory Work:**

**Directions for Laboratory work:**

- The list of experiments is given as a sample.
- Minimum 10 experiments should be carried out.
- At least one experiment should be selected from each group.

- Similar laboratory work fulfilling the objectives can also be considered.
- Each experiment should be simulated before verifying practically.
- As far as possible, **printed manual should be preferred** so that students can concentrate in laboratory experiments and related study.

**List of Experiments and Design based Problems (DP)/Open Ended Problem:**

1. To study Amplitude Modulation and Frequency Modulation.
2. To study and simulate Pulse Width Modulation.
3. To study digital communication using ASK, FSK and PSK.
4. To study RS-232, RS-485 and RJ-45 communication standards.
5. To study types of Cables and Interference.
6. To study Modbus Protocol.
7. To study HART Protocol.
8. To study CANBUS, Device Net and SDS system.
9. To study network topologies and Ethernet.
10. To study mobile communication and satellite communication.

**Major Equipment:**

Signal communication trainers.  
Data communication Protocol trainers.

**List of Open Source Software/learning website:**

Learning website:  
- <http://nptel.iitm.ac.in/courses.php>  
- <http://ocw.mit.edu>  
- <http://www.electrical-engineering-portal.com>  
- <http://en.wikipedia.org>  
- <https://www.anlog.com>  
- <https://www.protocols.com>

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.