GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Instrumentation and Control Engineering

Course / Subject Code : DI03017011

Course / Subject Name : Telemetry Systems

w. e. f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	ESC

Prerequisite:	Basic knowledge of industrial signals and sensors
Rationale:	In the process instrumentation, data from all the equipment is sent to centrally located control room for overall control. Telemetry is the science of measuring parameters and collecting data at remote or inaccessible points and transmitting them to receiving equipment for monitoring and taking action from optimum and safe operating point of view.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Install telemetry systems	U,A
02	Utilize various devices to combine analog and digital telemetry	U
03	Choose among various modern process data transmission buses	A,E
04	Install basic EIA 485 system	A
05	Observe safety in telemetry system for process industries.	U,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
2	0	2	3	70	30	20	30	150

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Course Content:

Unit No.	Content		No. of Hours	% of Weightage
1. Telemetry Principles	1.1	Telemetry)System Overview: Need of telemetry systems, Evolution of telemetry systems, functional blocks of a telemetry system	4	10
	1.2	Classify the different types of telemetry systems – Based on energy medium used (Pneumatic, Hydraulic Electrical-voltage-current-pulse, Optical) Based on signals (Analog, digital)		
	1.3	State standard output ranges of all types of telemetry systems		
2.Basic Installation Components	2.1	Components used in Hydraulic Transmissions: Function and requirements of some basic needed devices listed below : Reservoir, Strainers, Filters, Hydraulic Pumps(Centrifugal, reciprocating and Rotary) Lines - Types of tubes and pipes, fittings and connectors for impulse line tubing, Sealing Devices Types of Direction Control Valve Types of Accumulators	10	30
	2.2	Components of Pneumatic Telemetry system: Function and requirements of some basic needed devices listed below : • Receiver tank, Strainers, Filters Compressor - Centrifugal, reciprocating and Rotary • Lines -Types of Tubes and Pipes Fittings and connectors for Impulse Line tubing, • Sealing Devices • Junction boxes, Enclosures, clamps-P- U type, Numbering / Tagging system • Direction Control Valve - Types		
	2.3	Components of Electrical Telemetry: Function and requirements of some basic needed devices listed below : Cables, Junction boxes, Enclosures, connectors (Soldered/ Unsoldered – Screw/press fit), clamps-P- U type, Numbering/ Tagging system, Terminals Terminating types (Soldered-unsoldered (screwed , pressed, crimped)		

	2.4	Components of optical telemetry : Types of Switches, Couplers, Splitters,, Fibre optic connectors Name the types and parts of optical fibre connectors Describe the steps for installing a fibre optical connector		
3. Fundamentals of transmitting and receiving process data	3.1	Fundamentals of A to D converter, D to A converter, types of Antenna	6	20
	3.2	Justify the need of process data multiplexing and De-multiplexing in Telemetry		
	3.3	Describe the working principle of the following: Multiplexers: TDM, FDM, WDM, CDM		
	3.4	State merits and demerits of each type Multiplexer		
	3.5	Justify the need of Process Signal Modulation and Demodulation		
	3.6	Basics of modulation and demodulation		
	3.7	Fundamental block diagram and basic working for given Types of Modulation and demodulation: Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM), Pulse Modulation (PM), Pulse Amplitude Modulation (PAM), Pulse Position Modulation (PPM), Pulse Width Modulation (PWM), Pulse Code Modulation (PCM)		
4. Process Data Transmission Standards and Industrial Buses	4.1	The modes of transmission : Serial and parallel transmission, (Basic concepts only)	6	20
	4.2	Basics of EIA 232 : Major elements, troubleshooting and troubleshooting tools used for the standard		
	4.3	EIA 485 Interface standard : Basic installation and care to be taken while installation List the troubleshooting tools with their typical uses EIA 232 to EIA485 converter basic structure and wiring diagram		
	4.4	List features and applications of Industrial Instrumentation Communication Buses (HART,Mod Bus,Profibus, Foundation Fieldbus, CANbus, EtherCAT, DeviceNet, ProfiNet, AS-interface)		
5.	5.1	State the importance of incorporating safety measures in process telemetry	4	20
	5.2	List Safety Barrier Zones with their types		

Precautions and safety measures	5.3	State the procedure to test Safety Barriers		
	5.4	Justify the need of isolation of process signals in control room to field and vice versa		
	5.5	State the procedure to test electrical and optical Isolation		
	5.6	Describe the effect of Back reflection and methods to minimise this using optical isolator		
	Total		**30**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**50**	**20**	**0**	**10**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Telemetry Principles , D. Patranabis, TMH, New Delhi latest Edition
2. Telecontrol Methods and Applications of Telemetry and Remote Control , Swoboda G., Reinhold Publishing Corp., London, 1991
3. Optical Fiber Communications, 3/E John M. Senior Pearson publications, New Delhi latest Edition
4. Pneumatic Controls , Joji P. Wiley India Edition, New Delhi latest Edition
5. Instrumentation Reference Book Edited by Walt Boyes B H publications, latest edition
6. Practical Industrial Data Networks, Steve Mackay et al., Elsevier publications,2004

(b) Open source software and website:

1. http://enginemechanics.tpub.com/14105/css/14105_31.htm for hydraulic transmission
2. http://www.fiber-optics.info/articles/couplers_splitters for fiber optics system components
3. http://www.becbapatla.ac.in/ece/lab/EC%20351%20AC.pdf --- for practical

Suggested Course Practical List:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	CO	Approx. hours required.
1	Set up a Basic Hydraulic Telemetry System	2	1	4
2	Set up a Basic Pneumatic Telemetry System and demonstrate true and live zeroes	2	1	4
3	Tag a Process System by a tie warp/engraved number plate/painted for various process signals to a Junction Box	2	1	2
4	Connect a process signal to a given recorder/Indicator using 2-wire electric Telemetry	2,3	1,2	2
5	Test the operation of Analog-to-digital converter Digital-to-analog converter	3	2	2
6	Crimp UTP cable with RJ45 connector	1,4	1,3	2
7	Build a frequency division multiplexing and demultiplexing circuit and to verify its operation for a temperature/pressure/level/flow process signal	3	2	2
8	Determine the percentage modulation in a process signal for Amplitude Modulated System using CRO	3	2	2
9	Determine the modulation index and bandwidth for various frequency modulating for a temperature/pressure/level/flow process signal	3	2	2
10	Determine the attenuation (dB/km) of optical fiber in transmitting for a temperature/pressure/level/flow process signal	2,,3,5	1,2,5	2
11	Test operation of an opto-coupler in transmitting a temperature/pressure/level/flow process signal	2,5	1,2,5	2
12	Implement EIA 485 standards	4	4	2
13	Implement EIA 232 to EIA 485 conversion.	4	4	2
14	Test safety barrier using Zener diode telemetry system.	5	5	2
Minimum 8 to 12 Practical to be performed(Total 28 Hours)				

List of Laboratory/Learning Resources Required:

1. Optical Fiber Testing Bench
2. All Types of Modulating and Demodulating Cards for Process Signals
3. All Types of Mulitplexing and Demultiplexing Cards for Process Signals

4. Tranreceiver Set
5. Hydraulic Telemetry Test Bench
6. Pneumatic Telemetry Test Bench
7. Electric Telemetry Test Bench
8. Precision Measuring Instruments for a temperature/pressure/level/flow process signal
9. Safety Barrier Test Bench
10. Test Bench for Industrial Buses

Suggested Project List: if feasible,

1. **Set up a hydraulic / optical /pneumatic / electric / industrial telemetry system.**

Suggested Activities for Students:

1. Presenting A Seminar
2. Do a case study on relevant topic
3. Visit market for search various components of telemetry systems and be aware of prices and specification

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