

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

TELEMETRY SYSTEM (Code: 3331702)

Diploma Programme in which this course is offered	Semester in which offered
Instrumentation and Control Engineering	3 rd semester

1. RATIONALE

In the process instrumentation, almost all the measurements are done remotely since data from one equipment is sent to other equipment for control. In some cases 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. The word 'telemetry' is derived from Greek roots: tele = remote and metron = measure. A diploma instrumentation engineer is therefore required to maintain telemetry systems in instrumentation used for monitoring and safe operations of the total system. Hence, it is essential for students to develop the associated skills by study this course deeply.

2. COMPETENCY ('Programme Outcome' according to NBA Terminology)

The course content should be taught and implemented with the aim to make the students competent enough

- **Maintain telemetry systems in instrumentation used for monitoring and safe operations of the total system**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Telemetry Principles	1a. Describe the block diagram a typical telemetry system 1b. Classify the different types of telemetry systems 1c. Describe each type of telemetry system with using relevant loop /block diagram 1d. Compare the merits and demerits of Hydraulic, Pneumatic and Electric Telemetry 1e. State standard output ranges of all types of telemetry systems	1.1 Telemetry System Overview: functional blocks of a telemetry system 1.2 Telemetry types: <ul style="list-style-type: none"> • Energy Medium – Pneumatic, Hydraulic • Electrical - Current, Pulse • Signal Type - Analog, Digital • Frequency Spectrum for telemetry application
UNIT II Hydraulic , Pneumatic and Electrical Telemetry Systems	2a. State strengths of fluid power with examples of hydraulic fluids 2b. With functions, state the components of a typical hydraulic telemetry system.	2.1 Strengths of fluid power with examples of hydraulic fluids 2.2 Components used in Hydraulic Transmissions: <ul style="list-style-type: none"> • 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 2.3 Types of Accumulators
	2c. With functions, state the components of a typical Pneumatic Telemetry system.	2.4 Components of Pneumatic Telemetry system: <ul style="list-style-type: none"> • 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

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	2d. With sketches label each component of the electrical telemetry system. State the steps to troubleshoot the electric telemetry loop	2.5 Electrical Telemetry Components of Electrical Telemetry: 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)
Unit – III Process Data Multiplexing / Demultiplexing Techniques	3a. Justify the need of process data multiplexing and Demultiplexing in Telemetry 3b. Describe the working principle of the following: Multiplexers: TDM, FDM, WDM, CDM 3c. State merits and demerits of each type Multiplexer	3.1 Multiplexing in Telemetry Systems 3.2 Types of Multiplexing – Time Division Multiplexing (TDM) , Frequency Division Multiplexing (FDM), Wavelength Division Multiplexing (WDM), Code Division Multiplexing (CDM)
Unit – IV Process Signal Modulation and Demodulation Techniques	4a. Justify the need of Process Signal Modulation and Demodulation 4b. Describe the modulation with block diagrams. 4c. Describe the following types of modulation: AM, FM, PM, PAM, PPM. PWM, PCM.	4.1 Modulation for Telemetry - Carrier Signal, Process Signal as Information 4.2 Types of Modulation: 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) and Demodulation of all
Unit – V Process Data Transmission Standards and Buses	5a. Describe the modes of transmission. 5b. Differentiate between guided / unguided transmission media 5c. Describe the features of each type of guided transmission media 5d. Name the types of unguided transmission media 5e. State the steps to be taken to maintain various buses used for	5.1 Mode of transmission: simplex, half duplex, Full duplex 5.2 Transmission Media: Guided and Unguided 5.3 Guided Media: Twisted Pair, Coaxial Pair, Optical Fibre 5.4 Unguided Media: Radio, FM, sky wave, space wave, Infrared

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	<p>transmitting signals</p> <p>5f. State the types and importance of Serial and parallel transmission standards for industrial data</p> <p>5g. Name the various Industrial Instrumentation Communication Buses with features their applications</p>	<p>5.5 Serial and parallel transmission standards,</p> <p>5.6 Industrial Instrumentation Communication Buses: Foundation Field Bus, Profibus, IEEE488 (GPIB), HART, SCAN - Open Bus</p>
<p>Unit – VI Optical Telemetry and Safety Measures</p>	<p>6a. Compare the features of various types of Fibre optic cables</p> <p>6b. Name the types and parts of optical fibre connectors</p> <p>6c. Describe the steps for installing a fibre optical connector</p> <p>6d. State the procedure to test an installed fibre optic connector</p> <p>6e. Describe the effect of Back reflection and methods to minimise this using optical isolator</p> <p>6f. With sketches state the functions of each components of the optical telemetry loop</p> <p>6a. State the importance of incorporating safety measures in process telemetry</p> <p>6b. List Safety Barrier Zones with their types</p> <p>6c. State the procedure to test Safety Barriers</p> <p>6d. Justify the need of isolation of process signals in control room to field and vice versa</p> <p>6e. State the procedure to test electrical and optical Isolation</p>	<p>6.1 Fibre optic Cable, Optical Fibre components: Types of Switches, Couplers, Splitters,, Fibre optic Connectors</p> <p>6.2 Elements of Optical Telemetry</p> <p>6.3 Safety Measures in Telemetry</p> <p>6.4 Safety barrier(zone)</p> <p>6.5 Isolation of signal (Electrical / optical)</p>

5. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Telemetry Principles	4	3	5	0	08
II	Telemetry -Hydraulic and Pneumatic and Electric	12	2	10	7	19
III	Process Data Multiplexing / Demultiplexing Techniques	6	2	6	4	12
IV	Process Signal Modulation and demodulation Techniques	4	2	2	2	06
V	Data Transmission Standards and Buses	6	2	6	2	10
VI	Optical Telemetry and Safety Measures	10	3	8	4	15
Total		42	14	37	19	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

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

6. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills (**Course Outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only course outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of Programme Outcomes/Course Outcomes in *affective domain* as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA terminology)	Approx Hrs. Required
1	II	Set up a Basic Hydraulic Telemetry System	4
2	II	Set up a Basic Pneumatic Telemetry System and demonstrate true and live zeroes	4
3	II	Connect a process signal to a given recorder/Indicator using 2-wire electric Telemetry	2
4	II	Connect a process signal to a given recorder/Indicator using 3-wire electric Telemetry	2
5	II	Connect a process signal to a given recorder/Indicator using 4-wire electric Telemetry	2
6	II	Tag a Process System by a tie warp/engraved number plate/painted for various process signals to a Junction Box and	4

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA terminology)	Approx Hrs. Required
		diversion of the field to the control panel.	
7	III	Test the operation of Analog-to-digital converter Digital-to-analog converter	2
8	III	Test a multiplexer and demultiplexer for multiprocess signal.	2
9	III	Build a frequency division multiplexing and demultiplexing circuit and to verify its operation for a temperature/pressure/level/flow process signal	2
10	IV	Determine the percentage modulation in a process signal for Amplitude Modulated System using CRO	2
11	IV	Determine the modulation index and bandwidth for various frequency modulating for a temperature/pressure/level/flow process signal	2
12	V	Implement RS 232 standards of serial transmission using hyper terminals of two computers	2
13	V	Implement RS 485 standards of serial transmission using hyper terminals of two computers	2
14	VI	Set up the digital optical channel for transmission of process signal with noise and observe the distortion of the output signal	2
15	VI	Determine the attenuation (dB/km) of optical fiber in transmitting for a temperature/pressure/level/flow process signal	2
16	VI	Test operation of an opto-coupler in transmitting a temperature/pressure/level/flow process signal	2
17	VI	Test safety barrier using Zener diode telemetry system.	2
Total			42

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- i. WEB Surfing for Advanced Techniques of Telemetry
- ii. Presenting A Seminar
- iii. Setting up Fibre Optic Control loop
- iv. Setting up Pneumatic Control loop
- v. Setting up Electrical Control loop

8. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Visits to Industries
- ii. Take small instrumentation components to the class when teaching
- iii. Video or animation films on working of different type of power stations from YouTube and other resources.
- iv. Mini project

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
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.	Data Communication Networks	Sanjay Sharma	S.K.Kataria and Sons, New Delhi 2008 or latest Edition
4.	Mechanical and Industrial Measurements (Process Instrumentation and Control)	R.K. Jain	Khanna Publishers New Delhi Latest Edition
5.	Optical Fiber Communications, 3/E	John M. Senior	Pearson publications, New Delhi latest Edition
6.	Pneumatic Controls	Joji P.	Wiley India Edition, New Delhi latest Edition
7.	Instrumentation Reference Book	Edited by Walt Boyes	B H publications, latest edition

B) List of Major Equipment/Materials with Broad Specifications

- i. 2 Nos. Of Computers with DACs & Printer
- ii. Optical Fiber Testing Bench
- iii. All Types of Modulating and Demodulating Cards for Process Signals
- iv. All Types of Multiplexing and Demultiplexing Cards for Process Signals
- v. Transceiver Set for
- vi. Hydraulic Telemetry Test Bench
- vii. Pneumatic Telemetry Test Bench
- viii. Electric Telemetry Test Bench
- ix. Precision Measuring Instruments for a temperature/pressure/level/flow process signal
- x. Safety Barrier Test Bench
- xi. Test Bench for Industrial Buses

C) List of Software/Learning Websites

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

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. R.R. Manchiganti**, HOD IC Engineering, Govt. Polytechnic Gandhinagar
- **Prof. R.P. Merchant**, HOD IC Engineering, Govt. Polytechnic Gandhinagar
- **Prof. M.N. Mulchandani**, OSD Continuing Education Centre, Ahmedabad
- **Prof. S. K. Raval**, Lecturer IC(SG) Engineering, Govt. Polytechnic Ahmedabad

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Anjali Potnis**, Associate Professor, Department of Electrical and Electronics Engineering
- **Dr. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering