

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2023 (COGC-2023)

Semester – III

Course Title: Industrial Telemetry

(Course Code: 1334103)

Diploma Programme in which this course is offered	Semester in which offered
Automation and Robotics	3 rd Semester

1. RATIONALE

Since data or information from one equipment is supplied to other equipment for achieving automation, virtually all measurements in industry/plant are conducted remotely. Data from all the devices may occasionally be routed to a central control center for overall management. The telemetry, the science of gathering data and measuring parameters at inaccessible or remote locations, sending it to receiving equipment for monitoring, and acting in a way that is both optimal and safe operation. The Greek words tele (for remote) and metron (for measure) are the source of the English word "telemetry." Therefore, it is essential to understand telemetry systems in the field of automation which is utilized for monitoring and secure system operations, by an automation engineer diploma is required. Therefore, it is crucial that students learn this concept in order to build the necessary skills.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Able to understand the importance of telemetry in Automation**
- **Able to select appropriate type of telemetry system for given application**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

CO1	Discover fundamentals of Telemetry System.
CO2	Investigate Modulation and Demodulation Techniques.
CO3	Examine Digital Communication Techniques.
CO4	Compare different Topologies and various Protocols.
CO5	Analyze Wireless Sensor Network.

Practical COs:

CO1	Troubleshoot Telemetry System.
CO2	Propose Technique for Modulation.
CO3	Recommend type of Protocol or Industrial Communication.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, CA - Continuous Assessment; ESE - End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. Some of the PrOs marked ‘*’ are compulsory, as they are crucial for that particular CO at the ‘Precision Level’ of Dave’s Taxonomy related to ‘Psychomotor Domain’.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Connect a process signal to a given recorder/Indicator using 2-wire electric Telemetry	1	2
2	Connect a process signal to a given recorder/Indicator using 3-wire electric Telemetry	1	2
3	Connect a process signal to a given recorder/Indicator using 4-wire electric Telemetry	1	2
4	Determine the percentage modulation in a process signal for Amplitude Modulated System using CRO	2	2
5	Determine the modulation index and bandwidth for various frequency modulating for a temperature/pressure/level/flow process signal	2	2
6	Implement RS 232 standards of serial transmission using hyper terminals of two computers	3	2
7	Implement RS 485 standards of serial transmission using hyper terminals of two computers	3	2
8	Study the Elements of Digital Communication system with its block diagram: source, channel, transmitter and receiver	3	2
9	Describe mode of transmission: simplex, half duplex, Full duplex	3	2
10	To study industrial Instrumentation Communication: Foundation Field Bus, Profibus, IEEE488 (GPIB), HART, SCAN - Open Bus	3	2
11	To study about various layers of the OSI model	4	2
12	To study about TCP/IP reference model.	4	2
13	To study about different elements of Wireless Sensor Network	5	2
14	To study about classification of Wireless Sensor Network	5	2
15	To study about Safety Measures in Telemetry systems	5	2
	Total		30

Note

- i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name
1	Voltage source, Current source, and Electronic workbench.
2	RF Signal Generator (10Hz to 100MHz)
3	Audio Oscillator (20Hz to 20KHz)
4	CRO 2/3/4 channel (25-100MHz)
5	Digital Multimeter
6	Pulse generator
7	Trainer Board for different Communication Modulation – Demodulation techniques.

7. AFFECTIVE DOMAIN OUTCOMES

The following **sample** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfil the development of this competency.

- a) Work as a leader/a team member for Mirco project.
- b) Follow safety practices and procedure in Lab.
- c) Realize the importance of engineering for societal development.
- d) Develop gradually the engineering mindset in day to day observation.
- e) Practice environmental friendly methods and processes. (Environment related)

8. UNDERPINNING THEORY

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
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<p>Unit – I Basics of Telemetry</p>	<p>1a. Describe function of each part of a typical Telemetry System using its block diagram.</p> <p>1b. Classify Telemetry Systems.</p> <p>1c. Describe each type of Telemetry System.</p> <p>1d. State standard output ranges of all types of Telemetry Systems.</p>	<p>1.1 Introduction of Telemetry System</p> <ul style="list-style-type: none"> i. Definition of Telemetry System ii. Need of Telemetry System <p>1.2 Block Diagram of Telemetry System</p> <p>1.3 Classification of Telemetry System</p> <p>1.4 Types of Telemetry System</p>
<p>Unit – II Modulation and Demodulation</p>	<p>2a. Describe Modulation and Demodulation process.</p> <p>2b. State the necessity of Modulation and Demodulation.</p> <p>2c. Classify Modulation Techniques.</p> <p>2d. Describe various types of Modulation.</p>	<p>2.1 Introduction of Modulation & Demodulation</p> <p>2.2 Need of Modulation & Demodulation</p> <p>2.3 Classification of Modulation Techniques</p> <p>2.4 Types of Modulation</p> <ul style="list-style-type: none"> i. Amplitude Modulation ii. Frequency Modulation iii. Phase Modulation iv. Pulse Amplitude Modulation v. Pulse Width Modulation vi. Pulse Position Modulation vii. Pulse Code Modulation <p>2.5 Demodulation</p>
<p>Unit - III Digital Communications</p>	<p>3a. State necessity of Digital Communication.</p> <p>3b. Describe block diagram of Digital Communication.</p> <p>3c. Describe various Transmission Modes.</p> <p>3d. State Advantage & Disadvantage of Digital Communication.</p> <p>3e. Discuss about various Transmission media.</p> <p>3f. Describe Serial & Parallel</p>	<p>3.1 Introduction to Digital Communication</p> <p>3.2 Elements of Digital Communication system</p> <p>3.3 Advantage & Disadvantage of Digital Communication system</p> <p>3.4 Mode of Transmission</p> <ul style="list-style-type: none"> i. Simplex Mode ii. Half Duplex Mode iii. Full Duplex Mode <p>3.5 Transmission Media</p> <ul style="list-style-type: none"> i. Guided Media: Twisted Pair, Coaxial Pair, Optical fiber ii. Unguided Media: Radio wave, Micro wave, Infrared <p>3.6 Serial & Parallel Transmission standards</p>

	<p>Transmission standards.</p> <p>3f. Describe Industrial Instrumentation communication.</p>	<p>i. Serial Transmission: RS-232, RS-422</p> <p>ii. Parallel Transmission: IEEE-488, IEEE-1284</p> <p>3.7 Industrial Instrumentation Communication: Foundation Field Bus, Profibus, IEEE488 (GPIB), HART, SCAN - Open Bus</p>
<p>Unit - IV Topology and Protocol</p>	<p>4a. State the necessity of Computer Networks.</p> <p>4b. Discuss the applications of Computer Networks.</p> <p>4c. Define the terms: Protocol, Interface, Services, Primitives, Semantics, syntax.</p> <p>4d. Compare various computer network topologies.</p> <p>4e. Describe the functions of each Layer of OSI Reference model.</p> <p>4f. Describe the functions of each Layer of TCP/IP Reference model.</p>	<p>4.1 Computer Network</p> <p>i. Need of Computer Network</p> <p>ii. Advantages & Disadvantages of Computer Network</p> <p>iii. Applications of Computer Network</p> <p>4.2 Network Topologies: Star, Ring, Bus, Mesh,, Tree and Hybrid</p> <p>4.3 Network Terminology: Protocol, Interface, Services, Primitives, Semantics, Syntax</p> <p>4.4 The OSI Model : Brief functional description of each layer</p> <p>4.5 The TCP/IP Reference Model: Brief functional description of each layer</p>
<p>Unit - V Wireless Sensor Network</p>	<p>5a. Describe the block diagram of Sensor Node.</p> <p>5b. Describe the Network Architecture.</p> <p>5c. Classify Wireless Sensor Networks.</p> <p>5d. Discuss the applications of Wireless Sensor Networks.</p>	<p>5.1 Introduction of WSN</p> <p>5.2 Elements of WSN</p> <p>i. Sensor node : Block Diagram</p> <p>ii. Network Architecture</p> <p>5.3 Types of WSN</p> <p>i. Terrestrial WSNs</p> <p>ii. Underground WSNs</p> <p>iii. Underwater WSNs</p> <p>iv. Multimedia WSNs</p> <p>v. Mobile WSNs</p> <p>5.4 Classification of WSN</p> <p>i. Static & Mobile</p> <p>ii. Deterministic & Non-deterministic</p> <p>iii. Single Base Station & Multi Base Station</p> <p>iv. Static Base Station & Mobile Base Station</p>

		v. Single-hop & Multi-hop WSN vi. Self-Reconfigurable & Non-Self Configurable vii. Homogeneous & Heterogeneous 5.5 Applications of WSN
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Note: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

9. SUGGESTED SPECIFICATION TABLE FOR SEMINAR FINAL ESE (VIVA) DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Basics of Telemetry	5	4	6	0	10
II	Modulation and Demodulation	7	3	8	7	18
III	Digital Communications	10	3	8	3	14
IV	Topology and Protocol	10	3	8	3	14
V	Wireless Sensor Network	10	3	8	3	14
Total		42	16	38	16	70

Legends: R=Remember, U=Understand, A=Apply and above (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.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Prepare journals based on practical performed in laboratory.
- Do assignments related to theory topics.
- Visit library and collect information from various magazines on recent developments in Industrial Telemetry and its applications and make report of that.
- Give seminar on Industrial Telemetry
- Take up a small technical project based on any advance theory topic.
- Visit industries to get practical knowledge and field experience and realize importance of Telemetry Systems.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

- Show video/animation to demonstrate the working principles, constructional features, testing and maintenance of different types of Telemetry Systems.
- Use flash/animations to explain the working of different Telemetry Systems.
- Arrange Industrial Visit for students.
- Ask students to explore internet about recent developments in field of Industrial Telemetry Systems and prepare seminar presentations on relevant topics.
- Give mini technical projects based on advance theory topics.

f) Arrange expert lectures of instrumentation engineers working in industries.

12. SUGGESTED MICRO-PROJECTS

Take up a small technical projects based on any advance theory topic.

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her at the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that he/she contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit a micro-project by the end of the semester to develop the industry oriented Cos.

13. SUGGESTED LEARNING RESOURCES (MUST READ ONES!!!)

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Tele control Methods and Applications of Telemetry and Remote Control	Swoboda G.	Reinhold Publishing Corp., London, 1991
2	Telemetry Principles	D. Patranabis	TMH, New Delhi latest Edition
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	Industrial Automation and Robotics	Er R K Rajput	S Chand
6	Robotics and Control	R K Mittal ; I Nagrath	McGraw Hill Education ISBN-10 : 9780070482937

14. SOFTWARE/LEARNING WEBSITES

- Analog communication: <https://nptel.ac.in/courses/117105143>
- Data Transmission: http://en.wikipedia.org/wiki/Data_transmission
- Modulation: <http://www.mathworks.in/matlabcentral/fileexchange/28416-pulse-codemodulation/>
- Data Communication: <http://ninjacraze.hubpages.com/hub/What-is-Data-Communication>

15. PO-COMPETENCY-CO MAPPING

Semester III	Industrial Telemetry (Course Code : 1334103)
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Competency & Course Outcomes	POs						
	PO1 Basic & Discipline specific knowledge	PO2 Problem Analysis	PO3 Design/ development of solutions	PO4 Engineering Tools, Experimentation & Testing	PO5 Engineering practices for society, sustainability & environment	PO6 Project Management	PO7 Life-long learning
CO1: Discover fundamentals of Telemetry System	3	2	2	1	-	-	1
CO2: Investigate Modulation and Demodulation Techniques	3	-	2	1	1	-	1
CO3: Examine Digital Communication Techniques	2	-	1	-	-	-	1
CO4: Compare different Topologies and various Protocols	1	-	1	-	-	-	-
CO5: Analyze Wireless Sensor Network	2	3	-	1	2	-	2

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Member – Board of Studies (GTU), Electrical and Allied branches

Prof. Suresh Z. Shyara, IC Engineering, AVPTI, Rajkot

Prof. Mahesh J. Vadhavaniya, IC Engineering, Government Polytechnic, Palanpur

Prof. Urvish P. Soni, IC Engineering, Government Polytechnic, Ahmedabad

Prof. Zankhana D. Mehta, IC Engineering, Government Polytechnic, Ahmedabad

Prof. Parth S. Thakar, IC Engineering, Government Polytechnic, Gandhinagar

GTU Resource Persons

Prof. Sejal K. Raval, IC Engineering, Government Polytechnic, Ahmedabad

Prof. Ravindra B. Gadhiya, IC Engineering, Government Polytechnic, Gandhinagar