GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: INSTRUMENTATION & CONTROL ENGINEERING
(COURSE CODE: 3351106)

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	5th Semester

1.   RATIONALE

Electronics is part and parcel of all modern instrumentation systems. Transducers, automatic process control, telemetry system, recorders, computer aided process control, data acquisition system and such others use a lot of electronics. Therefore, it is essential that every electronic and communication diploma engineer should know the basics of modern instrumentation and control systems so that the associated electronics can be maintained effectively. Hence, this course is developed to provide the fundamental knowledge of industrial instrumentation and control system to students to enable them to maintain the electronics modules.

2.   LIST OF COMPETENCY

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competency

- **Analyze different types of instrumentation and control systems**

3.   COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

   i.   Identify various types of instrumentation systems and their modules.
  ii.   Select appropriate transducer for measurement of physical parameters.
 iii.   Monitor working of different types of process control systems.
  iv.   Select appropriate types of telemetry system and recorders for relevant applications.
   v.   Analyzes various types of computer aided process control system.

4.   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
04	00	02	06	70	30	20	30	

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

5.   COURSE DETAILS

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
Unit-I Introduction to Instrumentation	1a. Describe different elements of instrumentation system with examples	1.1 Elements of instrumentation system including process and biomedical instrumentation
	1b. Classify the instrumentation systems	i. Null and Deflection ii. Control and Monitoring iii. Analog and Digital
	1c. With sketches describe various types of standard instrumentation signals	1.2 Standard instrumentation signals: Pneumatic, Current loop, 0-10 volts.
	1d. Justify the need of signal conditioning 1e. Explain different types of Signal conditioning systems	1.3 Signal conditioning: DC signal and AC signal conditioning.
Unit-II Measurement of Physical Parameters	2a. Describe measurement techniques of physical parameters like torque, length, speed, level	2.1 Measurement techniques i. Measurement of torque ii. Measurement of length iii. Measurement methods of level measurement: Laser, Microwave, Optical, Ultrasonic, Eddy current.
	2b. Explain working of magnetic flow meter	2.2 Magnetic flow meter
	2c. Describe different types of pressure measurement techniques	2.3 Pressure measurement techniques by i. Strain gauge, ii. Potentiometer, iii. Pressure switch
	2d. Classify temperature measurement techniques 2e. Describe working of different types of pyrometers	2.4 High and low temperature measurement i. Radiation type pyrometer ii. Optical type pyrometer
	2f. Explain working of various types of position sensors	2.5 Position sensor i. Resistive type ii. Optical type iii. Inductive type
	2g. Describe measurement techniques to measure humidity and moisture for different applications	2.6 Measurement of moisture and humidity
	2h. Describe working principle of Magneto-strictive, Hall effect, Ionization and Electrochemical Transducers	2.7 Special types of transducers: i. Magneto-strictive transducers ii. Hall effect Transducers iii. Ionization Transducers iv. Electrochemical Transducers

Unit	Major Learning Outcomes (outcomes in cognitive domain)		Topics and Sub-topics
Unit-III Automatic Process Control	3a.	Explain need for automatic process control system.	3.1 Need of automatic process control elements of process control
	3b.	Explain different elements of automatic process control system.	3.2 Advantages of automatic process control system
	3c.	Describe different modes of process control system	3.3 Modes of process control system: i. Open loop ii. Closed loop(manual, on-off, P, I, D, PI, PD, PID)
Unit-IV Telemetry System And Recorders	4a.	Differentiate the different types of telemetry systems	4.1 Electrical telemetry system (current, position, impulse)
	4b.	Explain working of various types of electronic telemetry systems.	4.2 Electronic telemetry system(pulse telemetry-Pulse Amplitude Modulation ,Pulse Frequency Modulation, Pulse Duration Modulation, Pulse position modulation)
	4c.	Describe the function of smart and intelligent transmitters.	4.3 Smart (intelligent) transmitters
	4d.	Explain the working of different types of recorders with block diagram	4.4 Recorders Types i. Strip chart ii. Circular chart iii. X-Y plotter
	4e.	Name the electronic components used in Telemetry System And Recorders	
Unit-V Computer Aided Control Systems	5a.	State the application of computers in process control.	5.1 Role of computer in process control
	5b.	Explain at the block diagram level the different elements of computer based control systems	5.2 Block diagram of the computer based control
	5c.	Describe the function of various blocks of CNC machine.	5.3 CNC machine, various blocks of CNC machine
	5d.	Describe the use of the different computer interfaces to connect various electronic devices.	5.4 Standard interfaces: RS-232,RS-422A,RS-485,GPIB
	5e.	Describe the functions of Data acquisition systems	5.4 Data acquisition system.
	5f.	Explain concept of virtual instrumentation.	5.5 Virtual Instrumentation: Conventional and Graphical Programming.

6.   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.	Introduction to Instrumentation	8	4	6	2	12
II.	Measurement of Physical Parameters	12	4	5	6	15
III.	Automatic Process Control	12	4	6	5	15
IV.	Transmitters, Telemetry System and Recorders	12	4	5	4	13
V.	Computer Aided Control Systems	12	6	4	5	15
Total		**56**	**22**	**26**	**22**	**70**

Legends: R = Remember; U = Understand; A = Apply 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.

7.   SUGGESTED LIST OF EXERCISES/PRACTICALS

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

*Note: outcomes in psychomotor domain are listed here as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty members should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercises	Approx Hrs. Required
1	I	Analyze standard instrumentation signals waveforms.	2
2	II	Test the performance of pressure type Potentiometer	2
3	II	Measure torque using strain gauge	2
4	II	Check the performance of synchros	2
5	II	Measure temperature using radiation/optical pyrometer	2
6	II	Measure pressure using strain gauge	2
7	II	Test a DC position control system	2
8	II	Measure water level using resistive transducer	2
9	II	Measure water level using capacitive transducer	2
10	II	Measure water Level using ultrasonic transducer	2

S. No.	Unit No.	Practical/Exercises	Approx Hrs. Required
11	II	Analyze the time response of second order processes with P Control	2
12	III	Analyze the time response of second order processes with P+I Control	2
13	III	Analyze the time response of second order processes with P+D Control	2
14	III	Analyze e the time response of second order processes with P+I+D Control	2
15	IV	Use x-y recorder and graphic recorder for the appropriate quantity measurement.	2
16	IV	Analyze performance of PAM type telemetry system	2
17	IV	Analyze performance of PPM type telemetry system	2
18	V	Analyze performance of data acquisition system	2
19	V	Transfer various type of data using RS-232,RS-422A,RS-485,GPIB standard cables.	2
Total Hours (perform practical from all units so that 28 hours are utilised)			**38**

8.   SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

   i.   Test different types of transducers using simulation software like Prosim, simulink, lab volt etc.
  ii.   Present seminar on any one topic related to the subject.
 iii.   Develop a small Instrumentation and Control project using LAB VIEW software.

9.   SPECIAL INSTRUCTIONAL STRATEGIES (if any)

   i.   Industrial Visit
  ii.   Internet based assignments
 iii.   Organising expert lecture
  iv.   Display of appropriate video films

10.   SUGGESTED LEARNING RESOURCES

A)   List of Books

S.No.	Title of Books	Author	Publication
1.	Industrial instrumentation and control	Singh, S.K.	TATA McGraw-Hill, New Delhi (Latest Edition)
2.	Introduction to Instrumentation and Control	Ghosh, A. K.	PHI Learning, New Delhi (Latest Edition)
3.	Electronic measurement & Instrumentation systems	Jones, Larry, Chin, A foster	Prentice Hall International Edition
4.	Industrial Instrumentation and Control	Kumar, Sunil	S.K.Kataria and Sons, New Delhi (Latest Edition)
5.	Transducers and	D. V. S. Murthy	PHI Learning, New Delhi

S.No.	Title of Books	Author	Publication (Latest Edition)
	Instrumentation		(Latest Edition)
6.	Industrial Instrumentation	Krishnaswamy, Vijayachitra, K. S.	New Age International, New Delhi (Latest Edition)
7.	Process Control Instrumentation Technology	Curtis D. Johnson	Pearson Publication, New Delhi
8.	Hand book of Maintenance Engineering.	Garg, H. P.	TATA McGraw-Hill, International Edition
9.	Computer-Based Industrial Control	Kant, Krishna	PHI Learning, New Delhi (Latest Edition)
10.	Virtual Instrumentation Using Lab View	Gupta, Sanjay and John, Joseph	TATA McGraw-Hill, New Delhi (Latest Edition)

B)   List of Major Equipment/Materials with Broad Specifications
   i.   Instrumentation and control trainer kits
  ii.   DC Regulated Power supply
 iii.   Function generator
  iv.   CRO
   v.   Digital Storage Oscilloscope

C)   List of Software/Learning Websites
Any simulation software that shows working of different instrumentation and control circuits like Prosim, simulink, LAB VIEW etc.

11.   COURSE CURRICULUM DEVELOPMENT COMMITTEE
   Faculty Members from Polytechnics
- **Shri B. P. Raval,**   Sr**.** Lecturer (EC), Govt. Polytechnic, Rajkot.
- **Shri T. R. Parmar,**   Sr**.** Lecturer (EC), Govt. Polytechnic, Palanpur.
- **Shri B.B.Renuka,**   Sr. Lecturer (EC), AVPTI, Rajkot.

   Coordinator and Faculty Members from NITTTR Bhopal
- **Prof. (Mrs.) Anjali Potnis,** Assistant Professor, Department of Electrical and Electronics Engineering.