GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

Course Title: Industrial Transducers
(Code: 3321701)

Diploma Programmes in which this course is offered	Semester in which offered
Instrumentation and Control Engineering	Second Semester

1. RATIONALE

Transducers are used in almost every industry and also in everyday life. Therefore, a diploma engineer in Instrumentation and Control Engineering is expected to use, installed and test the functioning of the different types of transducers being used for measuring non-electrical quantities in the industry. The course is intended to develop the basic understanding as well as the competency to install and test various transducers and sensors for measuring displacement, temperature, radiation, pressure, flow, level, pH, conductivity, density, velocity, viscosity and such others.

2. COMPETENCY

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

i. **Install/test different types of transducers.**

3. TEACHING AND EXAMINATION SCHEME

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

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

Note: It is the responsibility of the institute heads that marks for **PA of theory** & **ESE and PA of practical** for each student are entered online into the GTU Portal at the end of each semester within the dates specified by GTU.

4. DETAILED COURSE CONTENT

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I Transducer Basics	1a. State the basic requirements of transducers 1b. Classify and list the different types of Transducer 1c. Compare properties context to transducers	1.1 Basic requirements of transducers 1.2 Classification based on transduction phenomenon, type of application, types of input and output signal, electrical principle involved i) Active and passive transducer ii) Based on application iii) primary and secondary transducers iv) analog and digital transducer
	1d. Describe the static characteristics of transducers	1.3 Static characteristic - accuracy, precision, error, linearity, reproducibility, repeatability, threshold, dead zone, hysteresis, creep, span, range.
	1e. Describe the dynamic characteristics of transducers	1.4 Dynamic characteristic (fidelity), speed of response, lag, dynamic error
Unit– II Electrical Transducers	2a.Describe working principle of different types of electrical transducers. 2.b Describe the basic construction of different types of transducers 2.cTest the listed transducers	2.1 Resistive Transducers, Inductive Transducers, LVDT, RVDT i) Capacitive Transducers. ii) Piezoelectric Transducers. 2.2 Strain Gauge Transducers (unbonded and bonded)
Unit– III Thermoelectric Transducers	3a. Describe working principle of different types of thermo-electric transducers . 3b. Describe the basic construction of listed types of transducers 3c. Test the listed transducers	3.1 Thermocouple (E,J,K,R,S,T,M,N,B,C, types) 3.2 RTD (Pt, Cu, Ni types) 3.3 Thermistor and semiconductor sensors
Unit– IV Electro-optical and Radio Acoustic Transducers	4a. Describe working principle of different types of electro optical transducers 4b. State the salient features of different types of transducers 4c. Test the listed transducers	4.1 Opto-electronic devices: Photo emissive cells, LED, LCD, LDR, IR emitter, Photoconductive cells, Photodiode, Photo transistor, Photovoltaic cells, LASER, Opto-coupler 4.2 Digital Encoders (incremental/absolute)
	4.c Describe working principle of radioactive acoustic and ultrasonic transducers	4.3 Radioactive acoustic transducers, Geiger Muller counter 4.4 Ultrasonic transducers 4.5 Ion Selective Electrodes
Unit– V Industrial Primary Transducers	5a. Describe working principle of flow transducers. 5b. Describe the basic construction of	5.1 Flow Transducers – Orifice (Concentric, Eccentric Segmental, Quadrant), Venturi, Flow nozzle, Pitot tube, Flapper nozzle. 5.2 Level Transducers – Float type, Displacement type, Bubbler.

Unit	Major Learning Outcomes	Topics and Sub-topics
	different types of transducers 5c. State the salient features of different types of transducers 5d. Test the listed transducers	5.3 Pressure Transducers – Bellows, diaphragm (flat, corrugated, capsule), Bourdon tube (C type, spiral, helical), Swirl & de swirl, Proving ring, Piston cylinders. 5.4 Temperature Transducers – Bimetallic Thermometers, Filled system Thermometers 5.5.1 Magnetic flowmeter 2. Mass flowmeter 3. Radar level transmitter 4. Ultrasonic level transmitter 5. Displacer type level transmitter

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Transducer Basics	06	08	06	00	14
II	Electrical transducers	8	02	08	02	12
III	Thermoelectric Transducers	8	02	06	02	10
IV	Electro-optical and Radio Acoustic Transducers	8	02	08	02	12
V	Mechanical Transducers	12	02	14	06	22
	Total	**42**	**16**	**42**	**12**	**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 EXPERIMENTS

The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the above mentioned expected competency.

Sr. No.	Unit No.	Practical Exercise/Experiment	Approx. Hrs. Required
1	II	Test & plot characteristic (Vibration Vs Voltage) of piezo-electric crystal.	01
2	II	Test & plot characteristic of resistive transducers.	01
3	II	Test & plot characteristic of inductive transducers.	01
4	II	Test & plot characteristic (Strain Vs Resistance) of strain gauge.	01
5	III	Test & plot characteristic (Temperature Vs Voltage) of thermocouple (J,K,R,S,T,M,N,B,E).	02
6	III	Test & plot characteristic (Temperature Vs Resistance) of resistance temperature detector (Pt-100, Pt-1000).	02
7	III	Test & plot characteristic (Temperature Vs Resistance) of given thermistor.	02
8	IV	Test & plot characteristic (Luminance Vs Resistance) of LED.	01

Sr. No.	Unit No.	Practical Exercise/Experiment	Approx. Hrs. Required
9	IV	Test & plot characteristic (Luminance Vs Resistance) of IR emitter.	01
10	IV	Test & plot characteristic (Luminance Vs Resistance) of LDR.	01
11	IV	Test & plot characteristic (Luminance Vs Current) of photodiode.	01
12	IV	Test & plot characteristic (Luminance Vs Current) of phototransistor.	01
13	IV	Test & plot characteristic of Opto coupler.	01
14	V	Test & plot characteristic (Flow rate Vs Differential Pressure) of various orifices.	02
15	V	Test & plot characteristic (Flow rate Vs Pressure) of nozzle.	02
16	V	Test & plot characteristic (Flow rate Vs Differential Pressure) of venturi.	01
17	V	Test & plot characteristic (Flow rate Vs Differential Pressure) of Pitot tube.	01
18	V	Test & plot characteristics of various level transducers.	02
19	V	Test & plot characteristic (Pressure Vs Linear Displacement) of C type bourdon tube.	01
20	V	Test & plot characteristic (Pressure Vs Linear Displacement) of bellows.	01
21	V	Test & plot (Pressure Vs Linear Displacement) characteristic of diaphragm.	01
22	V	Test & plot characteristic (Temperature v/s Displacement) of bimetallic thermometer.	01
		Total	**28**

7. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

7.1 Students may be given exercises based on transducers to calculate important terms related to above topics.

7.2 Students may be asked to collect photographs using internet which is relevant to field application of various topics & have to prepare learning materials using it.

7.3 Teachers guided self learning activities, industrial visit, Course/library/internet/lab based mini projects etc.

7.4 Students activities like: course/ topic based seminars, Internet based assignments.

8. SUGGESTED LEARNING RESOURCES

A. List of Books

Sr.No.	Author	Title of the Book	Publication/Year
1	Sawhney, A. K.	Electrical & Electronic Measurements and Instrumentation	Dhanpat Rai & Co., 2005 or later Edition
2	Murty, D. V.	Transducers and Instrumentation	Prentice Hall of India, 2005 or later Edition
3	Jain, R. K.	Mechanical and Industrial measurements	Khanna Publishes, 2005 or later Edition
4	Rangan, Sharm, Mani	Instrumentation Devices and Systems	Tata McGraw Hill, 2005 or later Edition
5	Kalsi, H. S.	Electronic Instrumentation	Tata McGraw Hill, 3rd or later Edition
6	B.G. Liptak	Instrument Engineers' Handbook, Fourth Edition, Volume 1,2	CRC press

B. List of Major Equipment/ Instrument

8.1 Function generator(sine, square, triangle etc.with frequency range 10 Hz to 100 kHz)
8.2 DC power supply (-30 →0→+30 V with at least 1A current capacity)
8.3 Measuring equipments like CRO (preferably dual channel, 20Mhz)
8.4 Multimeter
8.5 Circuit/Trainer board/ Demonstration modules of relevant transducers.

C. List of Software/Learning Websites

1 http://en.wikipedia.org/wiki/Transducer
2 http://www.instrumentationtoday.com/

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnic

1 **Prof. R.J.Dhruv,** I/C HOD IC ENGG., A.V. Parekh Technical Institute, Rajkot
2 **Prof. R.P.Raiyani**, I/C HOD IC ENGG., Christ Polytechnic Institute, Rajkot
3 **Prof. N.B.Mehta**, LECTURER IC ENGG., Government Polytechnic, Ahmedabad
4 **Prof. H.P.Patel**, LECTURER IC ENGG., Government Polytechnic, Ahmedabad

Co-ordinator and Faculty Member from NITTTR Bhopal

1. **Dr. Joshua Earnest,** Professor and Head, Dept. of Electrical & Electronics Engg,
2. **Prof. A.S.Walkey**, Associate Professor, Dept. of Electrical & Electronics Engg,