GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Power Electronics

Course / Subject Code: DI02024021

Course / Subject Name: Sensors & Transducers

W. E. F. Academic Year:	2024-25
Semester:	2nd
Category of the Course:	PCC

Prerequisite:	Fundamental knowledge of senses.
Rationale:	With the advancement of technology measurement techniques have taken rapid strides with the introduction of different types of sensors and transducers. This course is intended to enable the student to understand the facts, concepts, principles and applications of the sensors and transducers and will be able to apply the same in almost all areas of electronics required to use and maintain different types of sensors and transducers used in the industry.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Classify sensors and transducers for various electronic applications.	R, U, A
02	Use Mechanical and Electromechanical Sensors and Transducers for specific application.	R, U, A
03	Use Capacitive Sensors and Transducers for specific application.	R, U, A
04	Use Thermal Sensors and Transducers for specific application.	R, U, A
05	Use Radiation Sensors and Transducers for specific application.	

**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 / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Characteristics & Classification of Sensors and Transducers** Role & Definition of Sensors, Transducers and Actuators. Characteristics: Range, Span, Input and output full scale, Resolution, Dynamic range, Accuracy, Errors, Repeatability, Sensitivity, Hysteresis, Nonlinearity saturation, Frequency response, Response time, Bandwidth, Calibration, Excitation, and Reliability. Classification of Sensors and Transducers. Basic requirements, Selection criteria, Advantages and Disadvantages of Electrical Transducer.	08	19
2.	**Mechanical and Electromechanical sensors/Transducers:** Strain gauge: Theory, type, materials, design consideration, sensitivity, Applications. Inductive sensor: common types- Reluctance change type, Mutual inductance change type, transformer action type, Magneto strictive type, constructions, applications. LVDT: Construction, material, output input relationship, I/O curve. Proximity sensor: types, construction, applications.	11	24
3.	**Capacitive sensors/Transducers:** Capacitive Transducers: Working Principle based on Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type. Piezoelectric element: piezoelectric effect, piezo capacitive force/displacement construction.	08	19
4.	**Thermal sensors:** Resistance change type: RTD materials, applications, Thermistor material, shape, ranges and accuracy specification. Thermocouple: types, thermoelectric power, general consideration, Junction semiconductor type IC.	10	21
5.	**Radiation sensors:** LDR: materials, construction, response, applications. Photovoltaic cells: construction, solar energy percentage utilization,	08	17

	cell energy and series-parallel connections.		
	Total	**45**	**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	**60**	**20**	**0**	**0**	**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:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Sensors, Actuators and Their Interfaces A multidisciplinary introduction 2nd Edition	Nathan Ida	The Institution of Engineering and Technology, UK ISBN 978-1-78561-835-2 (hard)
2	Electrical and Electronic Measurements and Instrumentation, 4/e	Er. R K Rajput	S. Chand Publishing, India ISBN: 9789385676017
3	Electrical and Electronics Measurement and Instrumentation	A.K. Shawney	Dhanpat Rai Publishing Co Pvt Ltd ISBN: 9788177001006
4	Transducers and Instrumentation 2nd Edition	DVS Murthy	PHI Learning P. Ltd ISBN-13 978-8120335691

(b) Open-source software and website:

1. https://www.electronics-tutorials.ws/io/io_1.html
2. https://www.electronicshub.org/sensors-and-transducers-introduction/
3. https://instrumentationtools.com/sensors-and-transducers-classification/
4. https://www.electricaltechnology.org/2018/11/types-sensors-applications.html
5. https://www.electrical4u.com/temperature-transducers/
6. https://sciencing.com/uses-photocells-5494652.html
7. https://www.akm.com/us/en/products/hall-sensor/tutorial/magnetic-sensor/
8. https://sl-coep.vlabs.ac.in/

Suggested Course Practical List:

S. No.	Practical Outcomes (PrOs)
1	Identify various characteristic parameters for selection of sensors.
2	Test the performance of Resistance Temperature Detector.
3	Test the performance of Thermistor.
4	Test the performance of Thermocouple.
5	Test the performance of Thermopiles.
6	Use Photodiode and Photo Transistor for sensing application.
7	Use capacitive sensor for the position and displacement application.
8	Use variable inductive sensor for the displacement application.
9	Test the performance of Inductive proximity sensor.
10	Test the performance of LVDT.
11	Test the performance of Strain gauge.
12	Test the performance of Load cell.
13	Test the performance of Piezoresistive Pressure sensor.
14	Use Piezoelectric Sensor for specific application.
15	Test the performance of LDR.

List of Laboratory/Learning Resources Required:

S. No.	Equipment Name with Broad Specifications
1.	Digital Multimeter.
2.	Inductive Transducer Trainer.
3.	LVDT Trainer.
4.	Proximity Transducer Trainer.
5.	Capacitive Transducer Trainer.
6.	RTD Transducer Trainer.
7.	Thermistor Transducer Trainer.
8.	Thermocouple Transducer Trainer.
9.	LDR Transducer Trainer.
10.	Photocell Transducer Trainer.
11.	Strain Gauge Transducer Trainer.

Suggested Project List:

1. Build various sensor-based demonstration boards using real sensors.
2. Build temperature measuring project using various sensors.
3. Build a demonstration board for displacement measurement using various transducers.

Suggested Activities for Students:

1.Prepare a table and interpret the technical specifications of various sensors and transducers using data sheets and market survey.

2.List of various products/appliances used in your home that contains various transducers. Also list names of those transducers.

3. Undertake a market survey for various sensors.

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