NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	Minor in Industrial Automation (Inter-disciplinary) Offered by B.Tech. in Electronics and Instrumentation Engineering
Semester:	VI
Course Code:	3EI403IE24
Course Title:	Sensors and Transducers
Course Type:	Department Elective- I under Minor (Interdisciplinary)
Year of introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. illustrate the fundamentals of sensors and transducers **(BL2)**
2. identify suitable sensors and transducers for specific applications **(BL3)**
3. explain the working of various sensors and transducers **(BL3)**
4. select and utilize different sensors in measurement systems. **(BL4)**

Contents	**Teaching hours (Total 45)**

Unit-I   Introduction to sensors and transducers — 04

Definitions of sensors and transducers, Active and passive transducers, Primary and secondary measurands. Overview of static and dynamic characteristics

Unit-II   Electrical sensors — 09

Variable Resistance Sensors: Potentiometers, strain-gauges, practical applications

Variable Capacitance Sensors: Linear motion capacitor, Rotary capacitor, practical applications

Variable Inductance Sensors: Types of inductive sensing, commonly sensed measurands and applications

Piezoelectric Sensors: Theory and design of piezoelectric sensors, Applications

Unit-III   Thermoelectric and thermo-resistive Sensors — 08

Thermoelectric theory, Thermoelectric laws, Thermocouples, Types of thermocouples, cold junction compensation, RTD, Thermistors, Diode junction sensors, Lead wire resistance compensation, practical applications

Unit-IV   Sonic sensors & magnetic sensors — 06

Sonar Detection, Ultrasonic Detection, Hall-effect sensor, Magnetic reed sensor, Inductive pick-up coil, Applications

Unit-V   Optical sensors — 07

Photoconductive sensors – Photo-resistor, Photodiode, Photo-transistor, Photo-FET, LASCR, Laser diodes, Photoemissive sensors, Photovoltaic sensors

| Unit-VI | **Miscellaneous transducers** | 08 |

Pressure and flow sensors which are not covered under in above units (Elastic pressure transducers -Bourdon tube, Diaphragm, Capsule, Bellows, Vacuum gauges, Dead weight Tester, Head type flowmeters – Venturi, Orifice, Pitot tube, flow nozzle, Variable Area flowmeters, Turbine flowmeters etc.)

| Unit-VII | **Introduction to smart sensors** | 03 |

Definition of smart sensors, Working principle, Functional block diagram, Types of smart sensors, Difference between normal and smart sensors, Overview of applications of smart sensors.

Self Study:
The self -study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
This shall consist of at least 10 practicals based on the above syllabus.

Suggested Reading/References:
1. J. R. Carstens, Electrical Sensors and Transducers, Regents / Prentice Hall of India Publication
2. A. K. Ghosh, Introduction to Measurements and Instrumentation, Prentice Hall of India Publication
3. D. Patranabis, Sensors and Transducers, Prentice Hall of India Publication

Suggested List of Experiments:
1.	Obtain the steady state and dynamic characteristics of Thermo-resistive sensors	(02 Hrs)
2.	Obtain the steady state and dynamic characteristics of Thermo-electric sensors	(02 Hrs)
3.	Application of Thermo-resistive and Thermo-electric sensors for Temperature controller.	(02 Hrs)
4.	Obtain the characteristics of Linear Variable Differential Transformer	(02 Hrs)
5.	Application of Strain-gaug type sensors for weight measurement	(02 Hrs)
6.	Design of LDR based illumination controller.	(02 Hrs)
7.	Application of Orifice meter for flow measurement.	(02 Hrs)
8.	Application of Venturi meter for flow measurement.	(02 Hrs)
9.	Application of Rotameter for flow measurement	(02 Hrs)
10.	Application of Dead weight tester for calibration of pressure gauge	(02 Hrs)
11.	Application of Ultrasonic transducers for distance measurement	(02 Hrs)
12.	Obtain characteristics of variour opto-electronic devices	(02 Hrs)

L = Lecture, T = Tutorial, P = Practical, C = Credit