Course Name: Sensor and Transducer
Course Code: EE 802B
Credit: 3

Prerequisites:

Sl. No.	Subject	Description	Level of Study
01	Basic Electrical & Electronics Engineering	Electrostatics, Electromagnetism	1st Sem, 2nd Sem
02	Electrical & Electronics Measurement	Method of measurement, Measurement system	4th sem

Course Objective:

- To make students familiar with the constructions and working principle of different types of sensors and transducers.
- To make students aware about the measuring instruments and the methods of measurement and the use of different transducers.

Course Outcomes:

At the end of the course, a student will be able to:

1. Use concepts in common methods for converting a physical parameter into an electrical quantity
2. Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light
3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
4. Predict correctly the expected performance of various sensors
5. Locate different type of sensors used in real life applications and paraphrase their importance
6. Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers and develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.

CO- PO mapping:

CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE-802 B.	**1**	3	3	2	1	2	2	2	1	3	2	2	1
EE-802 B.	**2**	2	1	3	3	2	1	2	2	1	2	2	1
EE-802 B.	**3**	2	1	2	2	3	2	2	1	2	2	2	1
EE-802 B.	**4**	2	2	3	2	1	1	2	2	3	2	1	2
EE-802 B.	**5**	2	3	2	1	2	2	3	2	2	3	2	2
EE-802 B.	**6**	2	3	3	2	1	1	2	3	2	1	1	2
		*** Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium)3: Substantial (High) and It there is no correlation, put "-"**											

Syllabus Indicating CO:

Module No.	Content	Relevant CO's
1	**Mechanical and Electromechanical sensor:** Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. **Strain gauge:** Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. **Inductive sensor:** common types- Reluctance change type, Mutual inductance change type, transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis. **LVDT:** Construction, material, output input relationship, I/O curve, discussion. **Proximity sensor**	**CO1, CO2, CO5**
2	**Capacitive sensors:** Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics. Piezoelectric element: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors.	**CO1, CO2, CO3**
3	**Thermal sensors:** Material expansion type: solid, liquid, gas & vapor Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification. Thermo emf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type.	**CO1,CO2, CO3, CO4**
4	**Magnetic sensors:** Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics. Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response. Geiger counters, Scintillation detectors, Introduction to smart sensors	**CO1,CO2, CO3, CO4**

Gaps in Syllabus:

Sl. No.	Gap	Action taken	Relevance to POs
1	**Single transmission:** *This technique is very useful to deal with communication systems, but missing in the syllabus.* **Topics covered**: *Cable transmission of analog and digital signal, fiber optic signal transmission, radio, telemetry, pneumatic transmission*.	The various topics are addressed by **lecture classes,**	**PO 1, PO 2**
2	**Microelectromechanical Systems:** *This is a research oriented topic missing in the syllabus.* **Topics covered:** Material for manufacturing MEMS, Patterning, Lithography.	Additional **lecture classes** are organized to cover the topics. **Research literatures are provided**.	**PO 1, PO 2, PO 5**
3	**Smart Sensor :** *This is a recent important topic on sensor* **Topics covered:** component of smart sensor, General architecture of smart sensor, Industrial application of smart sensor.	Additional **lecture classes** are organized to cover the topics.	**PO 1, PO 2, PO 3, PO 5**

Lecture Plan:

Sl. No.	Date	Topics	Remarks
1& 2		**Mechanical and Electromechanical sensor:** Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity.	
3		**Strain gauge:** Theory, type, materials, design consideration,	
4 & 5		Sensitivity, gauge factor, variation with temperature, adhesive, rosettes.	
6		**Inductive sensor:** common types- Reluctance change type, Mutual inductance change type.	
7 & 8		Transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable	
9		Ferromagnetic plunger type, short analysis.	
10 & 11		**LVDT:** Construction, material, output input relationship, I/O curve, discussion.	
12		**Proximity sensor**	
13 &14		**Capacitive sensors:** Variable distance-parallel plate type, variable area- parallel plate.	
15 & 16		**Capacitive sensors:** serrated plate/teeth type, cylindrical type,	
17		**Capacitive sensors:** variable dielectric constant type, calculation of sensitivity.	
18		Stretched diaphragm type: microphone, response characteristics	
19		Piezoelectric element: piezoelectric effect, charge and voltage co-efficient	
20		Crystal model, materials, natural & synthetic type, their comparison,	
21		Force & stress sensing, ultrasonic sensors.	
22 & 23		**Thermal sensors:** Material expansion type: solid, liquid, gas & vapor	
24 & 25		Resistance change type: RTD materials, tip sensitive & stem sensitive type	
26 & 27		Thermister material, shape, ranges and accuracy specification.	
28 & 29		Thermo emf sensor: types, thermoelectric power, general consideration,	
30		Junction semiconductor type IC and PTAT type.	
31		Radiation sensors: types, characteristics and comparison.	
32		Pyroelectric type.	
33 & 34		**Magnetic sensors:** Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors,	
35 & 36		Thomson effect, Hall effect, and Hall drive, performance characteristics. Geiger counters, Scintillation detectors, Introduction to smart sensors	
37 & 38		Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response.	
39		Geiger counters,	
40		Scintillation detectors,	
41		Introduction to smart sensors	

Recommended Books:

1. Sensor & transducers, D. Patranabis, 2nd edition, PHI
2. Instrument transducers, H.K.P. Neubert, Oxford University press.
3. Measurement systems: application & design, E.A.Doebelin, Mc Graw Hill