Course Type	Course Code	Name of the Course	L	T	P	Credit
OE	EEO406	Modern Sensors and Signal Conditioning Circuits	3	0	0	9

Course Objectives:

The objective of the course is to develop an understanding of the construction, working principle of modern sensors and the associated signal conditioning circuits.

Learning Outcomes:

Upon the completion of the course, students will:

- Understand the working principle of various modern sensors.
- Understand the design aspects of efficient analog and digital signal conditioning circuits.
- Know about challenges while designing the circuits and different methods to address them.
- Get knowledge of fault-diagnosis of sensors.

Unit No.	Topics to be covered	Lecture Hours	Learning Outcome
1.	Overview on sensors, Types of errors, Measurement uncertainty, Concept of linearity and its importance, Regressing analysis for linear and non-linear sensors. Sensor calibration,	04	Understanding of sensors, their characteristics.
2.	Sensors for measuring pressure, temperature, air-flow, humidity, linear displacement, frequency, etc. Need of signal conditioning circuits, Basic electronic circuits, Detailed error analysis of an Instrumentation amplifier, Sampling, Nyquist Principle and Valvano Postulate, Analog-to-Digital Conversion	09	Acquire knowledge on various sensors, importance of signal conditioning and basic operation of common electronic circuits.
3.	Direct-Digital measurement using dual-slope based circuit and voltage-to-frequency converters, Low valued resistance measurement. Linearizing circuits for non-linear natured quarter and half-bridge-based strain gauge, resistive temperature sensors, Measurement errors due to non-idealities of signal conditioning circuits and solutions. Noise analysis and elimination. Sensors based on induced current phenomenon, Analog and digital linearizing signal conditioning circuits for GMR-based sensors.	08	Understand direct-digital measurement methods, design aspects of analog and digital signal conditioning circuits for various resistive sensors.
4	Fluxgate magnetometers. Analog and direct-digital signal conditioning techniques for TMR angular position sensor for half-circle and full-circle range. Phase-demodulation based digitizer for TMR angle sensor. Concept of ratiometric measurement and its implementation. Error analysis. Application of relaxation oscillator-based measurement technique for bridge connected sensors	08	Acquire in depth knowledge on TMR angle sensor and linearizing techniques.
5	Piezoelectric and MEMS-based accelerometer. Fabrication and working. Frequency response of MEMS accelerometer, Challenges in signal conditioning circuit. MEMS gyroscope: Coriolis effect. Direct-microcontroller interface for resistive and capacitive sensors.	07	Understanding MEMS devices and their applications.
6	Optoelectronic device, Fibre optic sensors, Introduction to smart sensor and Fiber Bragg grating sensor, Measurement of temperature, distance, etc. Beer Lamberts Law. Pulse oximeter: construction and working. Gas sensors, their response and signal conditioning circuits. Classification and identification of various sensor faults.	06	Understanding pulse oximetry, gas sensors and sensor faults.

Text book:

1. Ramaon Pallas-Arney and John G. Webster: Sensors and Signal Conditioning

Reference Books:

1. Earnest O. Doeblin: Measurement Systems – Application and Design
2. Alok Barua: Fundamentals of Industrial Instrumentation.
3. Winncy Y. Du: Resistive, Capacitive, Inductive, and Magnetic Sensor Technologies.