Short Syllabus

BCSE420L Sensors, Actuators and Signal Conditioning (2-0-0-2)

Basics of Energy Transformation - Introduction to sensors and transducers, Principle of sensing and transduction, Classification of sensors; Performance Characteristics of Sensors - Actuator Performance and Selection - Measurement of Industrial Parameters - Measurement of temperature, Measurement of pressure, Measurement of distance; Signal Conditioning - Data Acquisition System - Sensor Technology.

Course Code	Course Title	L	T	P	C
BCSE420L	Sensors, Actuators and Signal Conditioning	2	0	0	2
Pre-requisite	NIL	Syllabus Version			
		1.0			

Course Objectives:

1. To summarize and analyze the different types of sensors, signal conditioning circuits, and actuators.
2. To introduce students the criteria for selecting a sensor for a particular measurement.
3. To elucidate students the types of actuators: electrical, pneumatic, and hydraulic and enlighten their operation.
4. To familiarize students with the basic techniques of designing the required signal conditioning for a particular sensor.

Course Outcomes:

After the completion of the course, student will be able to:

1. Comprehend, classify and analyze the behavior of different types of sensors.
2. Analyze the characteristics and performance measures of sensors and select suitable sensor for the given industrial applications.
3. Gain the knowledge about the types of actuators: electrical, pneumatic, and hydraulic, performance criteria and selection.
4. Elucidate the construction and working of various industrial parameters / devices used to measure temperature, pressure, flow, level and displacement.
5. Design the sensor interfacing and signal conditioning for various applications.
6. Implement the data acquisition systems with different sensors for real-time applications.
7. Realize the trends in sensor technology, industrial network and automation.
8. Conduct experiments and measurements in laboratory and realize hands-on experience on real components, sensors and actuators.

Module:1	Basics of Energy Transformation	2 hours

Introduction to sensors and transducers, Principle of sensing and transduction, Classification of sensors.

Module:2	Performance Characteristics of Sensors	4 hours

Static characteristics: accuracy, precision, resolution, sensitivity, linearity, span and range - Dynamic characteristics, Mathematical model of transducer: zero, first and second, Response to impulse, step, ramp and sinusoidal inputs, Selection criteria of sensor.

Module:3	Actuator Performance and Selection	5 hours

Electrical actuating systems: solid-state switches, solenoids and electric motors: DC motor, stepper motor, and Inertial measurement unit, Mechanical actuating systems: types of motion, kinematic chains, cams and gears, Pneumatic and hydraulic actuating systems: diaphragms, bellows and control valves.

Module:4	Measurement of Industrial Parameters	6 hours

Measurement of temperature: thermistor and LM35, Measurement of pressure: strain gauge and piezoelectric type, Measurement of distance: ultrasonic, linear variable differential transformer and capacitance type, proximity sensor, Infrared sensor, Pulse oximeter and Tachometer.

Module:5	Signal Conditioning	5 hours

Amplification, Filtering, Multiplexing, Conversion techniques, Sensor interface design: Wheatstone bridge and operational amplifier circuits for various applications.

Module:6	**Data Acquisition System**	**3 hours**
Data Acquisition: single channel and multi-channel data acquisition, Data logging, Interfacing of sensors using DAQ cards, Applications: automobile and biological systems.		
Module:7	**Sensor Technology**	**3 hours**
Process of developing sensors, Trends in sensor technology and IC sensors, Sensor array's and multi-sensor systems, Smart sensors, Industrial network and automation.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	D. Patranabis, "Sensors and Actuators", 2nd Edition, PHI Learning, New Delhi, India, 2013.
2.	Ramon Pallas-Areny, John G. Webster, "Sensors and Signal Conditioning", 2nd Edition, Wiley India Pvt. Ltd., India, 2012.

Reference Books

1.	D. Patranabis, "Sensors and Transducers", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, India, 2011.
2.	Jon S. Wilson, "Sensor Technology Hand Book", Newnes Publishing Company, Boston, USA, 2005.
3.	A.K. Sawhney, Puneet Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Co. Pvt. Ltd., New Delhi, India, 2014.

Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).

Recommended by Board of Studies	13-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022