BCSE311L	Sensors and Actuator Devices	L	T	P	C
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Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To create a conceptual understanding of the basic principles of sensors, actuators, and their operations
2. To analyze the real-world problems and provide solutions using sensors and actuators
3. To promote awareness regarding recent developments in the fields of sensors and actuators

Course Outcomes

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

1. Classify different Sensors & Actuators based on various physical phenomena and differentiate their performance characteristics
2. Analyze the working principles of thermal, optical & electric sensors and actuators to interpret their mathematical model
3. Interpret the functional principles of magnetic, thermal & Chemical sensors and actuators to interpret their mathematical model
4. Select the relevant sensors and actuators to design real-time data acquisition from ambience via case studies

Module:1	Overview of Sensors and Actuators	4 hours

The five senses: vision, hearing, smell, taste, and touch – Definitions: Sensors & Actuators – Overview of Sensor and Actuator classifications – Performance characteristics of Sensors & Actuators: Transfer Function, Range, Span, Input and Output Full Scale, Resolution, and Dynamic Range - Calibration & Reliability

Module:2	Temperature Sensors and Thermal Actuators	3 hours

Thermoresistive sensors: Thermistors, Resistance temperature, and silicon resistive sensors – Thermoelectric sensors – Other Temperature sensors: Optical and Acoustical – Thermomechanical Sensors and Actuators – Case study: B*reath analyzer* using temperature

Module:3	Optical Sensors and Actuators	4 hours

Principles of Optics: Optical units – Quantum effects – Quantum-based Optical sensors – Photoelectric sensors – Charge coupled device (CCD) based – Thermal-based Optical sensors – Active infrared (AFIR) sensors – Optical Actuators – Case study: Liquid Level Indicator using Optical Sensor**s**

Module:4	Electric and Magnetic Sensors and Actuators	4 hours

Principles of Electric and Magnetic fields: Basic units – The Electric field: Capacitive Sensors & Actuators – Magnetic sensors and actuators – Magnetoresistance – Magnetostrictive Sensors and Actuators – Magnetometers – Magnetic actuators: Voice Coil Actuators, Motors as Actuators & Magnetic Solenoid Actuators and Magnetic Valves – Case Study: Speed sensing and odometer in a car using smart sensors

Module:5	Mechanical Sensors and Actuators	5 hours

Definitions and units – Force Sensors: Strain Gauges, Semiconductor Strain Gauges & Tactile Sensors – Accelerometers: Capacitive Accelerometers, Strain Gauge Accelerometers & Magnetic Accelerometers – Pressure Sensors: Mechanical, Piezoresistive, Capacitive & Magnetic – Velocity sensing – Inertial sensors and actuators: Mechanical or Rotor & Optical Gyroscopes – Case study: Tire-pressure monitoring system using smart sensors

Module:6	Acoustic Sensors and Actuators	3 hours

Definitions and units – Elastic waves and their properties – Microphones: Carbon, Magnetic, Ribbon and Capacitive Microphones – Piezoelectric effect – Piezoelectric Sensors – Acoustic Actuators: Loudspeakers, Headphones and Buzzers - Magnetic and Piezoelectric – Ultrasonic sensors and actuators – Case Study: Ultrasonic parking system		
Module:7	**Chemical Sensors and Actuators**	**5 hours**
Chemical units and Definitions – Electrochemical sensors: Metal Oxide Sensors and Solid Electrolyte Sensors – Potentiometric smart sensors: Glass Membranes, Soluble Inorganic Salt Membrane and Polymer - Immobilized Ionophore Membranes sensors – Thermochemical, Optical, Mass humidity gas sensors – Chemical Actuators: The Catalytic Converter - The Airbag System using smart sensors – Case study: Water quality monitoring system		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 Hours**

Text Book(s)

1. Nathan Ida, “Sensors, Actuators and their Interfaces - A Multidisciplinary Introduction”, 2020, 2nd Edition, IET, United Kingdom.

Reference Books

1. Jacob Fraden, “Handbook of Modern Sensors Physics, Designs, and Applications”, 2016, 5th Edition, Springer, Switzerland.
2. Subhas Chandra Mukhopadhyay, Octavian Adrian Postolache, Krishanthi P. Jayasundera, Akshya K. Swain, “Sensors for Everyday Life Environmental and Food Engineering”, 2017, Volume 23, Springer, Switzerland.

Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022