JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA
<u>19ABS31-SENSORS AND ACTUATORS FOR ENGINEERING APPLICATIONS</u>
(Open Elective-I)

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**
- To provide exposure to various kinds of sensors, actuators and their Engineering applications.
- Capable of understanding the principles and physics of various kinds of sensors from macro to micro/nano level.

## UNIT – 1: Introduction to sensors                                    9 Hrs
**Content of the Unit – I**
Sensors, Sensor systems, Nanosensors, -Types of sensors(based on Functions, temperature, pressure, strain, ranging and motion, time- active and passive sensors). Materials used and their fabrication process (Deposition, Pattern and Etching), General characteristics of sensors. Actuators, Functional diagram of actuators, Design of Actuators, Types of actuators (Hydraulic, Pneumatic, Mechanical, Electromagnetic, EAP and EM actuators). Applications of Actuators.
**Learning Outcomes:**
At the end of this unit, the student will be able to
- Classify different types of Sensors, Actuators and their characteristics
- Identifies the applications of Actuators in different fields
- Explain about different fabrication process of Sensors
- Illustrate functional diagram of Actuators

## UNIT – II: Mechanical sensors                                    9 Hrs
**Content of the Unit – II**
Principles of mechanical sensors (piezoresistivity, piezoelectricity, capacitive, inductive and resonant techniques), Displacement sensors, velocity sensors, Torque sensors, flow sensors, Micro and nanosensors, Multimodal nanosensors.
**Learning Outcomes:**
At the end of this unit, the student will be able to
- Summarize various types of Mechanical sensors
- Explain the working principle of different types mechanical sensors
- Identifies the applications of Mechanical sensors in different environmental conditions
- Understand the basic concepts of micro and nano sensors

## UNIT – III: Thermal sensors and Magnetic sensors                    9 Hrs
**Content of the Unit – III**
Introduction – Principles of Thermal sensors, Thermocouples, Types of thermocouples, Bi-metallic thermometer, Resistance Temperature Detectors (RTD), Advantages and Applications of these temperature sensors.
Introduction, Difference between conventional and magnetic sensors, Types of magnetic sensors (Low field, Earth field and BIAS magnetic field sensors), Working of variable reluctance sensors, Inductive sensors (LVDT), Eddy current sensors, Hall effect sensors, Applications of magnetic sensors.
**Learning Outcomes:**
At the end of this unit, the student will be able to
- Analyse the difference between conventional sensors and magnetic sensors
- Explain the working principle of different magnetic sensors
- Identifies the applications of Thermal and Magnetic sensors
- Summarize various types of thermal and magnetic sensors

## UNIT – IV: Electronic and Optical Sensors-I · 9 Hrs

**Content of the Unit – IV**

Introduction, Block diagram of electronic sensor system, Microelectronic sensors, semiconductor strain gauge, Gas sensors – Basic principle and working, Applications of electronic sensors – Electronic nose. Optical system components, Solid state optical systems, Optical radiation sources.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain the working and principle of various electronic and optical sensors
- Explain the block diagram of electronic sensor system
- Identifies the applications Electronic sensors in various fields
- Identify the various optical, solid state system components

## UNIT – V: Electronic and Optical Sensors –II 9 Hrs

**Content of the Unit – V**

Optical system components, Solid state optical systems, Optical transmitter and filters type (Geometrical optics, Fiber optics, optical Filters), Solid state photoelectric sensors, Photoconductive cells, Photo junction sensors, photon couplers, Example: MEMS transducers, Sensors calibration and compensation.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the optical system components and solid state optical systems
- Classify different types of Optical filters
- Explain the solid state photoelectric sensors, photo junction sensors and photoconductive cells
- Understand basics of MEMS transducers, sensors calibration and compensation

**Text Books:**

1. Sensors and Signal Conditioning Wiley-Blackwell, 2008 Jacob Fraden,
2. Piezoelectric Sensors and Actuators: Fundamentals and Applications, Springer,2018 Senturia S. D.

**Reference Books:**

1. Doebelin, "Measurement Systems: Application and Design", McGraw Hill Kogakusha Ltd.
2. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim "Microsensors, MEMS and Smart Devices", New York: Wiley, 2001.
3. Henry Bolte, "Sensors – A Comprehensive Sensors", John Wiley.
4. Handbook of modern sensors, Springer, Stefan Johann Rupitsch.
5. Microsystem Design, Kluwer Academic Publisher, 2001 J.D. Plummer, M.D. Deal, P.G. Griffin

**Course Outcomes:**

At the end of this Course the student will be able to

- recognize the need of sensors
- types of sensors which they will able to utilize for the concerned engineering application