Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May / June 2026

Date: 25-05-2026 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B.Tech	
Course Code : EEE3104	**Course Name**: Smart Sensors for Engineering Applications	
Semester: VI	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	14	14	14	24	34

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	A smart monitoring system uses a device to convert real-world signals into electrical outputs for a controller.	2 Marks	L2	CO1
2.	A measurement system uses both a thermocouple and a strain gauge. Differentiate between active and passive transducers based on this scenario with suitable examples.	2 Marks	L2	CO1
3.	In a smart irrigation system, a device measures soil moisture and sends signals to control water supply. Explain what a sensor is in this context.	2 Marks	L2	CO2
4.	An automatic security light uses a PIR sensor to detect human movement at night. Explain how the PIR sensor works to detect motion in this system.	2 Marks	L2	CO2
5.	An engineer selects a resistive transducer for a low-cost sensing application. Analyze one advantage and one limitation of this choice in the given scenario.	2 Marks	L2	CO3
6.	In an industrial setup, an engineer selects a capacitive transducer for level measurement. List the applications of capacitive transducers.	2 Marks	L2	CO3
7.	In a smart home system, multiple sensors (temperature, motion, and light) are combined to automate operations. What is meant by sensor integration?	2 Marks	L2	CO4
8.	A remote agricultural field uses wireless sensors for soil moisture monitoring. State one advantage of wireless communication in sensors.	2 Marks	L2	CO4
9.	In a medical diagnostic lab, a device detects specific enzymes in a blood sample. What is a Biosensor?	2 Marks	L2	CO5

10.	An aircraft needs to continuously monitor its altitude during flight. Which sensor is used to measure altitude in an aircraft?	2 Marks	L2	CO5

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	A capacitive transducer is a sensor that converts a physical quantity into a change in capacitance. Sketch and explain the working principle of a capacitive pressure transducer that operates based on varying plate area. Derive the expression for sensitivity in terms of the change in capacitance with respect to the change in displacement. How does pressure affect the capacitance, and what role does sensitivity play in determining the accuracy of this transducer?	10 Marks	L2	CO1
		Or			
12.	**a.**	Thermistor is widely used for temperature measurement, control, and protection**.** Explain the working principle of a thermistor as a temperature transducer. Describe how the resistance of a thermistor varies with temperature and classify thermistors based on their temperature–resistance characteristics. A certain thermistor has a 10 kΩ resistance at 25°C and 4 kΩ resistance at 100^0C. Find the value of β. Explain the significance of the β in characterizing the thermistor's temperature response.	10 Marks	L2	CO1
13.	**a.**	While designing a smart monitoring system, an engineer selects sensors based on their working principles. Classify sensors based on their principle of operation. Explain any five types with suitable examples. For analyte of concentration 50mM, resistance is 3 kΩ and for 400mM, it is 11 kΩ. What is the sensitivity of sensor? What is the sensitivity of the sensor at 450mM? What is the threshold offset and range of the sensor?	10 Marks	L3	CO2
		Or			
14.	**a.**	While designing an environmental monitoring system, an engineer selects sensors based on the physical quantities to be measured. Describe the classification of sensors based on measurand with examples. Find Accuracy and Precision of the two temperature sensors T1 and T2 used to measure the temperature of boiling water 5 times and the readings are: T1: 96.5 °C, 101.5 °C, 100 °C, 99.8 °C, 96 °C T2: 97.5 °C, 98.5 °C, 100.5 °C, 99.95 °C, 99.1 °C	10 Marks	L3	CO2
15.	**a.**	Design a smart sensor system that utilizes RF telemetry for wireless data transmission. Illustrate the system with a neat block diagram, explain its working principle, and analyze the key components involved.	10 Marks	L2	CO3
		Or			
16.	**a.**	Sensors play a vital role across multiple industries, each requiring specific types of sensors based on application needs.	10 Marks	L2	CO3

		Compare the sensors used in the following sectors: • Healthcare • Manufacturing • Automotive In your answer, discuss: • Types of sensors used in each sector • Their working purpose • Key differences in requirements such as accuracy, response time, and reliability • Specific applications in each industry			
17.	**a.**	A mobile robot uses an incremental encoder with a resolution of 500 pulses per revolution mounted on a wheel of radius 10 cm. If the encoder registers 2500 pulses in 5 seconds, determine: i) The linear distance travelled by the robot ii) The average velocity of the robot.	10 Marks	L3	CO5
		Or			
18.	**a.**	A mobile robot is designed to automatically switch ON its headlights in low-light conditions using a Light Dependent Resistor (LDR). The LDR has a resistance of 1 k Ω in bright light and 10 k Ω in darkness. The LDR is connected in a voltage divider circuit with a fixed resistor of 5 k Ω across a 5 V supply. The output voltage is fed to a comparator circuit, which turns ON the headlights when the output voltage exceeds 2 V. Based on this system, determine: 1. The output voltage of the sensor in bright light and darkness 2. Whether the robot headlights will turn ON in each condition 3. The value of LDR resistance at which the headlights just start turning ON (threshold condition)	10 Marks	L3	CO5
19.	**a.**	A smart sensor integrates sensing, signal processing, and communication capabilities within a single system, enabling intelligent decision-making in modern engineering applications. (a) Draw a neat labelled diagram of a smart sensor architecture. (b) Explain the overall architecture of a smart sensor in detail. (c) Describe the major components of a smart sensor, including: • Sensing element • Signal conditioning unit • Analog-to-Digital Converter (ADC) • Microcontroller/processor • Memory unit • Communication interface (d) Discuss how smart sensors improve accuracy, reliability, and automation compared to conventional sensors.	20 Marks	L2	CO4

		1. Introduction (2 Marks) 2. Neat Labeled Diagram (4 Marks) 3. Architecture Explanation (4 Marks) 4. Explanation of Major Components (8 Marks) 5. Advantages over Conventional Sensors (2 Marks)			
		Or			
20.	**a.**	Sensor technology has undergone significant transformation from basic measurement devices to intelligent systems used in modern applications. (a) Trace the evolution of sensor technology from conventional sensors to smart sensors. (b) Compare conventional and smart sensors in terms of functionality, performance, and applications. (c) Explain the key technological advancements that enabled this evolution. (d) Discuss the impact of smart sensors in modern engineering systems such as robotics, healthcare, and IoT. 1. Introduction (2 Marks) 2. Evolution of Sensor Technology (6 Marks) 3. Comparison: Conventional vs Smart Sensors (4 Marks) 4. Key Technological Advancements (4 Marks) 5. Impact of Smart Sensors (3 Marks) 6. Conclusion (1 Mark)	20 Marks	L2	CO4
21.	**a.**	In a smart healthcare environment, multiple sensors are integrated for diagnosis and monitoring. Classify medical sensors and explain each category with applications. In a pulse oximeter, the following values are measured: At Red light (660 nm): AC = 0.8, DC = 4, At Infrared light (940 nm):AC = 0.4, DC = 5. Calculate the oxygen saturation (SpO_2) using the empirical relation.	20 Marks	L3	CO5
		Or			
22.	**a.**	Explain the concept of a Home Automation System. Draw a neat block diagram and describe the working of the system with suitable sensors used in a smart home. An aircraft uses a barometric pressure sensor (altimeter) to estimate its altitude. The standard atmospheric pressure at sea level is 101.3 kPa. At a certain instant, the onboard sensor measures the atmospheric pressure as 80 kPa. The relationship between altitude $h$and pressure is given by: $$h = 8430 \ln\left(\frac{P_0}{P}\right)$$ • where $P_0$is sea-level pressure and $P$is the measured pressure. Calculate: i) The altitude of the aircraft ii) Explain the significance of pressure sensors in aircraft navigation.	20 Marks	L3	CO5