



**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

MAKE UP EXAMINATION-JAN 2023

Course Code: EEE1006

Course Name: Smart Sensors for Engineering Applications

Program : B-Tech

Date: 23-JAN-2023

Time: 09.30 AM – 12.30 PM

Max Marks: 100

Weightage: 50%

Instructions:

- (i) Read the all questions carefully and answer accordingly.
(ii) Scientific/ Non programmable calculators are allowed

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks.

(10Qx 2M= 20M)

1. A transducer is a device that converts energy from one form to another. Transducers may be classified according to their application, method of energy conversion, nature of the output signal, and so on. _____ transducers require external power supply for their operation.

- (a) Passive (b) Inverse (c) Active (d) Secondary

(C.O.No.1) [Knowledge]

2. A Temperature Transducer is a device that converts the thermal quantity into any physical quantity such as mechanical energy, pressure and electrical signals etc. Thermistor is an example of temperature transducer and it exhibits _____

- a) Negative temperature coefficient (b) Positive temperature coefficient
c) Seebeck Effect (d) Coupling effect

(C.O.No.1) [Knowledge]

3. The phototransistor is a three-layer semiconductor device which has a light-sensitive base region. In a phototransistor, a small change in the base current will lead to a comparatively higher change in the _____

- a) Emitter Current (b) Gate current (c) Collector Current (d) Drain Current

(C.O.No.2) [Knowledge]

4. A proximity sensor is a sensor that is able to detect the presence of nearby objects without any physical contact. An inductive proximity sensor comprises four main components coil, _____, Schmitt Trigger, and output switching circuit

- a) Capacitor (b) Oscillator (c) Emitter (d) Zero voltage detector

(C.O.No.2) [Knowledge]

5. Smart sensors are devices that take information from a physical environment and use embedded microprocessors and wireless communication to monitor, examine, and maintain various systems. _____ is not a configuration of a smart sensor.

- (a) Transducer (b) Network interface (c) Processor (d) None of these

(C.O.No.3) [Knowledge]

6. Strain gauge is a passive transducer that converts the applied force, pressure, torque etc., into an electrical signal which can be measured. Electrical strain gauge works on the principle of _____

(a)Variation of capacitance (b)Variation of inductance (c)Variation of area (d)Variation of resistance

(C.O.No.1) [Knowledge]

7. A Capacitive Transducer is a passive transducer which is used to measure the pressure, displacement, and other physical quantities. When the distance between the plates of the capacitor increases _____

a) Capacitance decreases

b) Capacitance Increases

c) Dielectric Strength increases

d) Dielectric Strength decreases

(C.O.No.1) [Knowledge]

8. A pressure sensor is a device that senses pressure and converts it into an electric signal where the amount depends upon the pressure applied. Pneumatic or Pressure sensors are electro-mechanical devices that can identify forces or pressure in different types of _____

a) Solids

b) Liquids

c) Gases

d) Both liquids and gases.

(C.O.No.2) [Knowledge]

9. PIR sensors use a pair of pyroelectric sensors to detect heat energy in the surrounding environments. The PIR sensor is designed to detect the _____ emitted naturally from the human body.

a) Infrared Radiation

b) Micro-wave radiation

c) Ultrasonic radiation

d) X-radiation.

(C.O.No.2) [Knowledge]

10. Micro-electro-mechanical systems (MEMS) is the integration of mechanical elements, sensors, actuators and electronics on a common silicon substrate through microfabrication technology.

Microelectronics integrated circuit in MEMS package can be thought as the _____ of a system

(a) Brain

(b) Arms

(c) Eyes

(d) All of these

(C.O.No.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries TEN marks.

(5Qx10M=50M)

11. Mr. Abhinav, a student of Presidency University, Bengaluru was conducting an experiment in control system laboratory where he had to acquire and monitor the real time temperature data from the hot oven and take appropriate control actions using PID Controller as per the temperature variations. He was in a dilemma as to which type of transducer should be used to accomplish the task. Dr Lokesh, The Professor in-charge, in the lab hinted the student to use a transducer which utilizes Seebeck effect for measurement of temperature. Explain the principle of operation of the whole process after identifying the best suitable transducer for the above as suggested by the professor.

(C.O.No.1) [Comprehension]

12. Ms. Tina went to a shopping mall for purchasing garments. Before entering the mall, the security guard stopped her at the entrance for security check. The security guard used a non-contact sensor to detect the presence of any metal objects with that lady. A non-contact sensor uses wear-free technology, the sensor experiences no friction on the moving parts, and this eliminates wear and tear and mechanical failure. Comment on the type of sensor used and explain the working of it with neat diagram.

(C.O.No.2) [Comprehension]

13. Assume that, you are the technical expert in a company that deals with automation. Presidency University wants to implement smart sensor-based systems for automation in class rooms. How

would you explain to the concerned about the basic architectural components of such smart sensor systems?

(C.O.No.3) [Comprehension]

14. Automobile sensors are intelligent sensors which are now a vital part of any modern automobile design, serving many different purposes. Auto manufacturers will need to combine smart sensors and advanced analytics to create truly successful smart cars. Explain in detail about any five smart sensor systems used in modern vehicles/electric vehicles.

(C.O.No.4) [Comprehension]

15. A home automation system combines hardware and software via a wireless network to control your home electronics and appliances through one device which could be a smartphone, tablet, or a specific central automation control hub system. These devices can be controlled remotely even when you're not at home. Explain the types of devices that can be operated via a home automation controller and describe them in brief highlighting the role of smart sensors used in it.

(C.O.No.4) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries FIFTEEN marks.

(2Qx15M=30M)

16. The piezoelectric effect results from the linear electromechanical interaction between the mechanical and electrical states in crystalline materials with no inversion symmetry. The piezoelectric effect is a reversible process: materials exhibiting the piezoelectric effect also exhibit the reverse piezoelectric effect, the internal generation of a mechanical strain resulting from an applied electrical field. A piezoelectric crystal having dimensions of 5 mm x 5 mm x 1.5 mm and a voltage sensitivity of 0.055 V-m/N is used for measurement of force exerted. The voltage developed is 100 volts.

a) Identify the unknown quantities that could be computed from the given data. [5M]

b) Compute the unknown parameters. [10M]

(C.O.No.1) [Comprehension]

17. A linear resistance potentiometer is 50mm long and is uniformly wound with wire having a resistance of 10000Ω. Under normal conditions, the slider is at the center of potentiometer.

a) Compute the linear displacement when the resistance of the potentiometer as measured by Wheatstone bridge for two cases are i) 3850Ω ii) 7560Ω. [10M]

b) Are the two displacements in the same direction? [2M]

c) If it is possible to measure a minimum value of 10Ω resistance with the above arrangements, find the resolution of the potentiometer in mm. [3]

(C.O.No.1) [Comprehension]