PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

MID TERM EXAMINATION

Winter Semester: 2021 - 22

Course Code: EEE 1006

Course Name: Smart Sensors for Engineering Applications

Program & Sem: B-Tech & II Sem

Date: 13/MAY/2022

Time: 01:30 PM – 03:00 PM

Max Marks: 50

Weightage: 25%

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. Self-generating type transducers are_____ Transducers
(a) Passive   (b) Inverse   (c) Active   (d) Secondary
(C.O.No.1) [Bloom's level: 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. The thermocouple circuit which is used to measure temperature works on _____effect.
(a) Peltier   (b) Seebeck   (c) Thomson   (d) Joule
(C.O.No.1) [Bloom's level: Knowledge]

3. A photodiode is a semiconductor device with a P-N junction that converts photons (or light) into electrical current. Photo-diodes work in _____
(a) Forward biased (b) Independent of forward and reverse biasing   (c) reverse biased (d) Any
configuration   (C.O.No.2) [Bloom's level: Knowledge]

4. A thermistor is a type of resistor whose resistance is strongly dependent on temperature, more so than in standard resistors. In general, the temperature coefficient of thermistor is _____
(a) Negative   (b) Positive   (c) Zero   (d) None of these
(C.O.No.2) [Bloom's level: Knowledge]

5. A measurement system consists of sensors, actuators, transducers and signal processing devices. _____ is not an example of transducer.
(a) Thermocouple   (b) Photo electric cell   (c) Analog voltmeter   (d) LVDT
(C.O.No.1) [Bloom's level: 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) [Bloom's level: Knowledge]

7. A Capacitive Transducer is a passive transducer which is used to measure the pressure, displacement, and other physical quantities. Capacitive transducer operate upon the principle of_____

(a) variation of over -lapping area of plates   (b) variation of separation of plates

(c) variation of relative permittivity of dielectric material between two plates (d) all of the above

(C.O.No.1) [Bloom's level: Knowledge]

8. The transducer which requires an external excitation to provide its output is referred to as a passive transducer. _____ is an example of a passive transducer.

(a) Thermocouple   (b) Piezoelectric transducer   (c) Strain gauge   (d) Photovoltaic cell

(C.O.No.1) [Bloom's level: Knowledge]

9. Stress is defined as _____

(a) Diameter per unit area   (b) length per unit area (c) weight per unit area   (d) force per unit area

(C.O.No.1) [Bloom's level: 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) [Bloom's level: Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries FIVE marks.   **(4Qx5M=20M)**

11. Mr. Vivek likes to experiment with sensors and transducers. Recently he had added a sound activated switch to his fan so that it would switch on and off when he clapped. Now he wants to control the fan speed by sensing the temperature in his room. Recommend a suitable transducer to Mr.Vivek best suited to his application and also help him in understanding the construction and working of the particular transducer.   (C.O.No.1) [Bloom's leve: Comprehension]

12. Some engineers got a contract of building an automatic monorail system, as their project in Bologne Italy, which would be powered mainly by the solar panels and additional power requirement will be met by some other sources of energy. The system is designed to operate using solar energy captured by photovoltaic panels placed at each monorail station and along the track's south facing side. It was suggested by some experts that a special type of a material which generates electrical power when compressed could be used as a source for meeting the additional power requirements by placing it on the track of the monorail system. Suggest and discuss about the material which could be used to fulfill the additional power requirements.

(C.O.No.1) [Bloom's level: Comprehension]

13. Assume that you are the technical expert in a company that deals with sensors. Presidency University wants to implement a non- contact sensor based system for detecting the presence of metallic object carried by the students in a certain lab before allowing them to the lab. Identify the sensor to be used and discuss the working of such sensors with neat diagram.

(C.O.No.2) [Bloom's level: Comprehension]

14. Ms. Arya is interested in doing projects and building circuits as her hobby. She has to use an isolating circuit in one of her projects to isolate control circuit using Arduino microcontroller from the power circuit which is intended to operate at 1kW level. She has purchased an optoisolator 4N35 as shown in figure 1 below. Ms. Arya is curious to know the sensor used in such systems and the working of such sensors. Help Ms. Arya in identifying the sensor used in optoisolator and discuss in brief about the working of the same. (C.O.No.2) [Bloom's level: Comprehension]
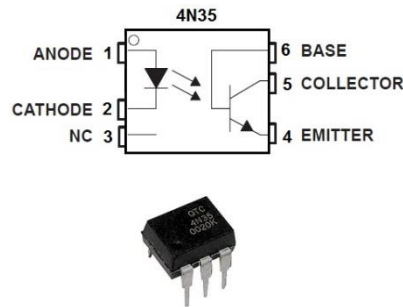

Figure. 1

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries TEN marks.   (1Qx10M=10M)

15. Piezoelectric materials are capable of transforming mechanical strain and vibration energy into electrical energy. Piezoelectric materials can be broadly classified as either crystalline, ceramic, or polymeric. The most commonly produced piezoelectric ceramics are lead zirconate titanate (PZT), barium titanate and lead titanate. A barium titanate pick up has the dimensions of 5mm x 5mm x1.25mm. The force acting on it is 5N. The charge sensitivity of barium titanate is 150pC/N and its permittivity is 12.5×10^{-9} F/m. If the Modulus of elasticity of barium titanate is 12×10^6 N/m^2, then:

   a) Identify any four unknown parameters that can be obtained from the above data.
   b) Calculate the values of these unknown parameters

(C.O.No.1) [Bloom's level: Comprehension]

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BENGALURU

SCHOOL OF ENGINEERING

END TERM EXAMINATION

Winter Semester: 2021 - 22

Course Code: EEE1006

Course Name: Smart Sensors for Engineering Applications

Program & Sem: B.Tech & II Sem

Date: 1st July 2022

Time: 01:00 PM to 04:00 PM

Max Marks: 100

Weightage: 50 %

Instructions:

(i)   Read the all questions carefully and answer accordingly.

(ii) All of you should bring your calculator

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks.   (10Qx 2M= 20M)

Q.NO.1 Gyroscopes are _____
a) Inertial Motion sensors	b) Pressure sensors
c) Voltage sensors	d) Humidity sensors

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

Q.NO.2 Which of the following is not a piezo electric sensor?
a) PZT	b) Roscelle salt
c) Quartz	d) None of the mentioned

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

Q.NO.3 Which of the following is not a configuration of a smart sensor?
a) Transducer	b) Network interface
c) Processor	d) None of the mentioned

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

Q.NO.4 Input signal to smart sensor is fed from _____
a) Power supply	b) Transducer
c) Voltmeter	d) All of the mentioned

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

Q.NO.5 Output of smart sensors will of _____
a) Analog	b) Digital
c) Analog and digital	d) None of the mentioned

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

Q.NO.6 Which of the following defines smartness of sensor?
a) Quality of data	b) Circuit size
c) Circuit components	d) All of the mentioned

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

Q.NO.7 Input data of smart sensor will be _____
a) Analog	b) Digital
c) Analog and digital	d) None of the mentioned

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

Q.NO.8 Smart Sensor performs
a) Logic function	b) Make decision
c) Two-way communication	d) All of the above

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

Q.NO.9 Transducer Interface Module (TIM) contains
a) A/D Converter	b) Signal Conditioning

c) Both (a) and (b)   d) None of these   (C.O.No.1) [Knowledge]

Q.NO.10 A_____ is thermally sensitive resistor that exhibits a large change in resistance.
a) Thermistor   b) Resistance Thermometer
c) Thermocouple   d) Semiconductor based sensor   (C.O.No.1) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the questions. Each question carries TEN marks   **(5Qx10M=50M)**

Q.NO.11 Mr. Joseph is planning to construct 5-star hotel and he wants to conserve the power in each of the rooms. The key power consumption equipment in the hotel is air conditioner and lights. Kindly suggest any two sensors with their working which would help him to conserve power.
(C.O.No.3) [Comprehension]

Q.NO.12 An Electric Vehicle Industry wants to increase the Global NCAP safety rating in their vehicle. For this, their main intention is to protect the safety of passenger while the car meet with an accident. Kindly suggest any two sensor which would help them to tackle this condition.
(C.O.No.3) [Comprehension]

Q.NO.13 The water wasted in agriculture is a key concern for Govt. of India. They are planning to adopt some mechanism to maintain the moisture of the soil and at the same time, the water should be used at optimum level. Please suggest any sensor which would perform this task to maintain the moisture at the optimum level.   (C.O.No.4) [Comprehension]

Q.NO.14 Mr. Jignesh purchased a brand-new smartphone for his regular activities. As his eyesight is very weak, he turned on the automatic balancing of brightness in his phone to tune the brightness of screen's smartphone with the outside environment. Which sensor would perform this task in his smartphone? Explain the working of the sensor with neat and clean diagram.
(C.O.No.3) [Comprehension]

Q.NO.15 Mrs. Geeta stays in rural area, and she is suffering from diabetes and blood pressure. She needs to regularly visit the doctor for physical examination but due to long distance between her home and hospital, she is unable to visit the doctor. Please suggest the convenient mode of data collection technique which would help Mrs. Geeta to send the data to the Doctor.
(C.O.No.3) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each question carries FIFTEEN marks.   **(2Qx15M=30M)**

Q.NO.7 A barium titanate pickup has the dimension of 5mmx5mmx1.25mm. The force acting on it is 5N. The charge sensitivity of barium titanate is 150 pC/N and its permittivity is $12.5x10^{-9}$ F/m. If the modulus of Elasticity of barium titanate is $12x10^6$ N/m^2. Calculate the strain. Also calculate the charge and the capacitance.   (C.O.No.3) [Comprehension]

Q.NO.8 A capacitive transducer uses two quartz diaphragms of area 750mm2 separated by a distance of 3.5mm. A pressure of 900 kN/m2 when applied to the top diaphragms produces a deflection of 0.6mm. The capacitance is 370 pF when no pressure is applied to the diaphragms. Find the value of capacitor after application of a pressure of 900 kN/m2.
(C.O.No.3) [Comprehension]

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Part A [Memory Recall Questions]

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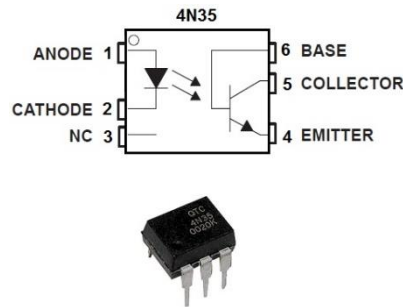

Figure. 1

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries TEN marks.   (1Qx10M=10M)

15. Piezoelectric materials are capable of transforming mechanical strain and vibration energy into electrical energy. Piezoelectric materials can be broadly classified as either crystalline, ceramic, or polymeric. The most commonly produced piezoelectric ceramics are lead zirconate titanate (PZT), barium titanate and lead titanate. A barium titanate pick up has the dimensions of 5mm x 5mm x1.25mm. The force acting on it is 5N. The charge sensitivity of barium titanate is 150pC/N and its permittivity is 12.5×10^{-9} F/m. If the Modulus of elasticity of barium titanate is 12×10^{6} N/m^2, then:

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