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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

MAKE-UP EXAMINATION - JULY 2024

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| **Semester :VI** | **Date :02-07-2024** |
| **Course Code :EEE3046** | **Time :** **01.30pm to 04.30pm** |
| **Course Name :** **Sensors and Transducers** | **Max Marks :100** |
| **Program :B.TECH** | **Weightage :50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 4M=20M** | | | |
| 1 | Capacitive and inductive sensors are two very common non-contacting sensors which are used to detect the presence of an object. List the differences between Capacitive and Inductive proximity sensors. | (CO 1) | [Knowledge] |
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| 2 | The piezoelectric effect is very useful for many applications that involve the production and detection of sound, generation of high voltages, electronic frequency generation, microbalances, and ultra fine focusing of optical assemblies. Define the terms piezoelectric effect and inverse piezoelectric effect. Also list the name of the materials that exhibits piezoelectric effect. | (CO 1) | [Knowledge] |
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| 3 | Light Sensors are photoelectric devices that convert light energy (photons) whether visible or infra-red light into an electrical signal. List different classifications of light sensors | (CO 2) | [Knowledge] |
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| 4 | Photomultipliers are photo emissive detectors which have a very high sensitivity due to an avalanche multiplication process, and also exhibit a high detection bandwidth. Describe the concept of dark current and how it affects the output of photomultiplier. | (CO 2) | [Knowledge] |
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| 5 | A thermocouple is a sensor that measures temperature. It consists of two different types of metals, joined together at one end. List any two types of thermocouples with their composition and the operating temperature range | (CO 3) | [Knowledge] |
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| 6 | The resistance of the conductor varies with the temperature. This property of the conductor is used for measuring the temperature using Resistance Temperature Detector. List the advantages and disadvantages of Resistance Temperature Detector. | (CO 3) | [Knowledge] |
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| 7 | Proximity Switch consists a sensor circuit and a driver circuit. The sensor circuit is used to detect any nearby objects. Draw a neat driver circuit for the proximity switch which uses NPN transistor and briefly explain its working | (CO 4) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 8 | Engine fuel control system require a sensor which senses the angular position of a valve and converts it into an electrical signal. Identify the sensor which can be used for in this application. With neat sketches explain its construction and working principle. | (CO 1) | [Comprehension] |
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| 9 | A noncontact sensor is required to use in a metal detector. The device should be suitable to use in outdoor and non-hygienic conditions and it should be compact. Identify the suitable sensor and with neat sketch explain its construction and working principle. | (CO 1) | [Comprehension] |
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| 10 | An oil and gas industry has installed its pipelines in a large geographical area including remote regions which can be affected by harsh environmental conditions. Its required to monitor the temperature and strain throughout the pipeline network in real time. Identify a suitable sensor technology which can be used for distributed sensing. With neat sketches explain its principle of operation and working. | (CO 2) | [Comprehension] |
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| 11 | A spectrophotometer used in a laboratory require a photodetector which measure the intensity of incident light. The photodetector should have high gain, good responsivity, large dynamic range and long lifetime. Identify a suitable photodetector for the spectrophotometer and with neat sketches explain its principle of operation and working. | (CO 2 ) | [Comprehension] |
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| 12 | A steel and iron industry need a temperature sensor for Measuring the temperature of molten metal. The sensor that can be used should be able to operate at very high temperature of around 1000 degree Celsius, simple, robust and cost-effective. Select a suitable temperature sensor that is suitable for this application. With neat sketch explain its construction and working | (CO 3) | [Comprehension] |
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| 13 | It is required to measure electrical energy utilized in kWH for a manufacturing industry. Identify the meter which records the number of units of electricity consumed. With a neat diagram, show the constructional features and working of meter that can be used | (CO 3) | [Comprehension] |
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| 14 | A manufacturing industry need a sensor for the remote monitoring of its plant temperature. The temperature has to be monitored continuously and is to be used for temperature control. Identify a sensor which is having a linear characteristic for this industry. With neat circuit diagram explain its working. | (CO 4) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 15M=30M** | | | |
| 15 | A piezoelectric crystal having dimensions of 5mm X 5mm X 1.5mm and a voltage sensitivity of 0.055 VN/m is used for force measurement. a) Calculate the force if the voltage developed is 100V. b) If the dimension of the crystal is changed to 2mm X 2mm X 1mm, estimate the voltage developed when the same force is acting on the crystal | (CO1) | [Application] |
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| 16 | The resistance of platinum resistance thermometer varies with the temperature. This property  is used for measuring the temperature. The resistance of a platinum wire of a platinum resistance thermometer at the ice point is 5Ω, and at steam point is 5.4Ω. When the thermometer is inserted in a hot bath, the resistance of the platinum wire is 6.2Ω. Find the temperature of the hot bath. List the advantages and disadvantages of platinum resistance thermometer. | (CO2) | [Application] |
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| 17 | a) The thermisto**r** is a solid state temperature sensing device which acts a bit like an electrical resistor but is temperature sensitive.  The working principle of a thermistor is that its resistance is dependent on its temperature. A 10kΩ NTC thermistor has a “β” value of 3455 between the temperature range of 25 degree Celcius and 100degree Celcius. Calculate its resistive value at 25degree Celcius and again at 100degree Celcius.  b)A thermocouple having an internal resistance of 30Ω and lead resistance of 10Ω produces a voltage of 100mV. If the output is read by a voltmeter having an internal resistance of 150Ω, what will be the voltage indicated by the voltmeter. | (CO3) | [Application] |
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