Reg. No.																

Question Paper Code	13209

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Third Semester

Electronics and Instrumentation Engineering

(Common to Instrumentation and Control Engineering)

20EIPC302 - SENSORS AND TRANSDUCERS

Regulations - 2020

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	A meter reads 115.50 V and the true value of the voltage is 115.44 V. Determine the static error for the instrument. (a) 0.02V (b) 0.03V (c) 0.04V (d) 0.06V	1	K3	CO1
2.	A 0-250 V voltmeter has a guaranteed accuracy of 2% of full-scale reading. The voltage measured by the voltmeter is 150 volts. Determine the limiting error in percentage. (a) 0.015 (b) 0.025 (c) 0.0333 (d) 0.0575	1	K3	CO1
3.	The measured value of a capacitor is 205.3 μF, whereas its True value is 201.4 μF. Determine the relative error. (a) 0.0194 (b) 0.0294 (c) 0.0356 (d) 0.055	1	K3	CO1
4.	The calibration procedures involve a comparison of the particular characteristic with……...with a higher accuracy than the instrument to be calibrated, or an instrument of known accuracy. (a) a primary standard (b) a secondary standard (c) Both primary and secondary standard (d) None of the mentioned	1	K2	CO1
5.	Find out the mean value of a distance observation set taken by the distance measurement sensor, Observations= {3,3.213,3.11,2.97} (a) 3.07325 (b) 3.2 (c) 3.125 (d) 3.0325	1	K2	CO2
6.	Let us consider the observation taken by an infrared sensor which predicts the distance of an object to be 3.32 cm but the actual value is 3.1 cm. find the relative error percentage? (a) 0.01 (b) 0.06 (c) 0.12 (d) 0.0709	1	K2	CO2
7.	Which of the following are related to passive transducer (a) Passive transducer cannot work in the absence of external power (b) Passive transducer can work in the absence of external power (c) Velocity can transducer using passive transducer (d) None of the mentioned are related	1	K2	CO2
8.	The overall operating range of the transducer is called? (a) Off-set (b) Drift (c) Span (d) Range	1	K2	CO2
9.	……..is the most commonly used metal for RTDs due to its stability and nearly linear temperature. (a) Platinum (b) Nickel (c) Copper (d) Tungsten	1	K2	CO3
10.	The resistance of a thermistor is 500 and its resistance temperature coefficient is 0.04/^{o}C. A measurement with a lead resistance of 10 ohm will cause an error of (a) 0.05^0 C (b) 0.01^0 C (c) 0.4^0 C (d) 0.8^0 C	1	K2	CO3
11.	For a certain thermistor, the material constant (B) is 3,000 Kelvin and its resistance at 27 C is 1,050 ohm. What is the temperature coefficient of resistances for this thermistor? (a) 0.033 10 ohm/ohm/C (b) -0.033 ohm/ohm/C (c) -3.33 ohm/ohm/C (d) -3.0 ohm/ohm/C	1	K2	CO3

12. What does a decrease in electrical resistance signify in the functioning of a strain gauge? *1 K2 CO3*
(a) The object is under compression (b) The object is being stretched
(c) The object has reached its elastic limit (d) The object is experiencing no stress

13. Induction potentiometers are normally designed for use at excitation frequencies of 50Hz or 400Hz providing sensitivities of the order of …….of rotation. *1 K2 CO4*
(a) 1volt/degree (b) 2volt/degree (c) 5volt/degree (d) 10volt/degree

14. The need for provision of a pair of slip rings and brushes to deliver the output signal makes the induction potentiometer less popular for which the range of measurement is limited to …… *1 K2 CO4*
(a) ± 5° (b) ± 10° (c) ± 15° (d) ± 25°

15. Maximum voltage is induced in a stator winding of a synchro transmitter when the rotor and the stator winding have what angle between them. *1 K2 CO4*
(a) 90 degrees (b) 60 degrees (c) 30 degrees (d) 0 degrees

16. For the level measurement of non-conducting type, there are ……..cylindrical electrodes used in an electrode assembly. *1 K2 CO4*
(a) One (b) Two (c) Three (d) Four

17. A piezoelectric crystal has a thickness of 2.5 mm and a voltage sensitivity of 0.05 Vm/N. The piezoelectric crystal is subjected to an external pressure of 1.6 x 106 N/m2, then the corresponding output voltage is *1 K2 CO5*
(a) 200 volts (b) 3.2 × 109 volts/m of thickness
(c) 0.07 × 10−9 V/(m^3/New) (d) 200 m volts

18. Calculate the Hall Effect coefficient when number of electrons in a semiconductor is 1020 *1 K2 CO5*
(a) 0.625 (b) 0.0625 (c) 6.25 (d) 62.5

19. On the bases of application of optic fiber sensor, which of the following is not considered to be the classification of fiber optic sensor? *1 K2 CO5*
(a) biomedical/photometric sensors (b) physical sensors
(c) thermal sensors (d) chemical sensors

20. MEMS consist of _____. *1 K1 CO5*
(a) Mechanical microstructure (b) Microsensors
(c) Microactuator (d) All of the mentioned

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. Draw the functional block diagram of a measurement system. *2 K1 CO1*
22. Define Absolute Unit. *2 K1 CO1*
23. Define static characteristics. *2 K1 CO2*
24. Define the unit of mass preserved at the International Bureau of weights and measures at Severs, Near Paris. *2 K2 CO2*
25. Mention the different types of strain gauge. *2 K1 CO3*
26. List the factors to be considered for bonded strain gauge. *2 K1 CO3*
27. List the desirable features of a capacitive transducer. *2 K1 CO4*
28. Identify any three applications of proximity sensors. *2 K2 CO4*
29. List the properties of piezoelectric crystals. *2 K1 CO5*
30. Compare MEMS sensors and Nano Sensors. *2 K2 CO5*

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) Discuss about the classification of transducers based on different characteristics. *10 K2 CO1*

OR

b) A mercury thermometer has a capillary tube of 0.3mm diameter. If the bulb is made of zero expansion material, what value must it have, if a sensitivity of 3mm/C˚ is desired? Assume operating temperature to be 20˚ C and coefficient of volumetric expansion of mercury is $0.181x10^{-3}$. *10 K3 CO1*

32.	a)	Discuss about the static characteristics.	*10*	*K2*	*CO2*
		OR			
	b)	Derive equations for response of a second order system when subjected to unit Step input.	*10*	*K2*	*CO2*
33.	a)	Define gauge factor. Derive the expression for gauge factor in strain gauge.	*10*	*K2*	*CO3*
		OR			
	b)	Describe the principle of operation and constructional details of resistance thermometers.	*10*	*K2*	*CO3*
34.	a)	Describe the principle of operation, construction details, and characteristics of LVDT.	*10*	*K2*	*CO4*
		OR			
	b)	Explain how capacitance of capacitive transducers can be varied. Also explain how it can be used for level measurement.	*10*	*K2*	*CO4*
35.	a)	Describe MEMS technology. Explain different manufacturing processes for MEMS.	*10*	*K2*	*CO5*
		OR			
	b)	Describe the principle of operation of Hall effect transducers. Discuss about its current sensing application.	*10*	*K2*	*CO5*
36.	a) i)	Describe the construction and working of a capacitor microphone.	*5*	*K2*	*CO4*
	ii)	Explain the working principle of LASER Sensor in detail.	*5*	*K2*	*CO5*
		OR			
	b) i)	Explain the Construction and working principle of Proximity sensor.	*5*	*K2*	*CO4*
	ii)	Explain the working principle of Film Sensor.	*5*	*K2*	*CO5*