[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
(2066)

16133(J) June-16

B. Tech 6th Semester Examination

Measurement and Control (NS)

ME-322

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question each from Sections A, B, C & D of the paper and all sub-parts of question no. 9 of Section E.

SECTION - A

1. (a) What are primary, secondary and tertiary measurements? Explain with examples. (10)

   (b) Measurement systems are classified as first order or second order systems. What determines the order of the system? The dynamic response of a temperature measuring instrument has been characterized by the equation $d\theta_0/dt=K(\theta_i-\theta_0)$, where θ_0 is the indicated temperature, θ_i is the input temperature and k is a numerical constant. Determine the transfer operator of the instrument and comment upon the order of the system. (10)

2. (a) What is calibration and why is it necessary for an instrument? How do you proceed to draw the calibration curve, a correction curve, and an error curve? (10)

   (b) The following readings are taken of a certain physical length with the help of a micrometer screw: 1.41, 1.45, 1.53, 1.54, 1.49, 1.51, 1.60, 1.55, 1.47, 1.65, 1.65 mm. Assuming that only random errors are present, calculate the arithmetic mean, the average deviation, variance and the probable error of the reading. (10)

[P.T.O.]

SECTION - B

3. What are transducers and how are they classified? Explain their importance in an instrumentation process. Give some examples of mechanical transducers. (20)

4. (a) List the main requirements of a strain gauge and mention the type of gauge which meets most of these requirements. Elaborate your answers by giving some examples. (10)

   (b) A single strain gauge having a resistance of 100 Ω and a gauge factor of 2.0 is mounted on a steel cantilever beam and connected in series with a 100 Ω ballast resistor and a 12 volt battery. The bending stress at the gauge fluctuates from 0 to $19.62\times10^8 N/m^2$. Assuming modulus of elasticity $E= 20.60\times10^{10}\ N/m^2$, compute the corresponding variation in output voltage. Can this variation be magnified to full scale on an oscilloscope? The oscilloscope has a sensitivity of 10 mV/cm of trace deflection and a screen length of 10 cm. (10)

SECTION - C

5. (a) List the various methods of flow measurement. What is the significance of term 'inferential' as applied to flow meters? Certain meters are known as variable head meters. Explain clearly what is meant by the designation variable head. (10)

   (b) It is a standard practice when using a dead weight tester to rotate the piston-platform combination, and to tap the gauge lightly while obtaining readings. Explain why? The piston and the platform of a dead-weight 20 N and the piston diameter is 1.25 cm. What weight must be added to the platform to produce a pressure of 175 kPa? (10)

6. (a) Compare and contrast the advantages and limitations of: (i) resistance thermometers and thermistors, (ii) thermocouple and resistance thermometers. (10)

(b) A thermopile arrangement of copper-constantan thermocouple consists of three junction pairs, and has the reference junction at 200°C. If the output voltage is 3.3 mV, determine the temperature of the measuring junction. Assume the following temperature- emf values which are based on reference junction at 0°C.

Temperature, °C:	100	200	250	
Voltage, mV:	4.22	9.23	11.95	(10)

SECTION - D

7. (a) How will you use an elastic transducer to measure force? Give at least three different configurations for such measurements and write down the relationship between the force and resulting deformation in each case. (12)

(b) A shaft transmits a maximum power of 50 kW when running at a constant speed of 1500 rpm. Measurements of torque are made by a pair of stain gauges which are bonded onto a specially machined portion of the shaft. Each gauge has a nominal resistance of R=120 Ω, gauge factor F=2.0 and are connected electrically to the two arms of a half-activated Wheatstone bridge circuit which is energised with an excitation voltage of 6 volts. If the gauges have a maximum strain of 0.0015, calculate the shaft diameter. The modulus of elasticity of the shaft material is 200 GN/m^2. Also work out the output voltage and the sensitivity of the measuring system. (8)

8. (a) Identify the following systems as open loop or control loop system. Give the reason there of: (i) automatic electric toaster, (ii) home shower with separate valves for hot and cold water, (iii) a man walking in a prescribed direction and (iv) anti-aircraft radar tracking system. (10)

(b) Figure 1 represents the signal flow graph for certain control system. Apply Manson's rule and workout the overall transmittance that prescribes the relation between the output Y and the input X. (10)

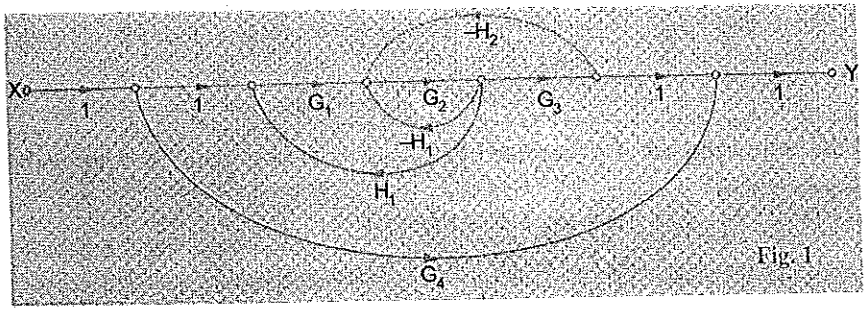

Fig. 1

SECTION - E
(Compulsory Question)

9. Write short answers of the following:

(a) Distinguish between bonded and unbounded type of resistance strain gauge.

(b) Distinguish between threshold and resolution

(c) List the metals used for resistance thermometers and give their useful temperature ranges.

(d) Classify the different types of dynamometers.

(e) Point out the merits and demerits in reference to open and closed loop control system. (4×5=20)