AGRICULTURAL AND FOOD ENGINEERING DEPARTMENT
INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date of Examination : 19.02.04 FN
Autumn Semester : 2003-2004

Full Marks - 40
Time : 2 hrs

Course : M. Tech in Farm Machinery & Power

Subject No. : AG60082

Subject Name :**Instrumentation and Research Techniques**

No. of Students : 08

Instruction : **ANSWER ALL QUESTIONS**

1. A first order thermometer is used to measure the temperature of air cycling at a rate of 1 cycle for every 5 min. The time constant of the thermometer is 20 sec. Calculate the attenuation of the indicated temperature in per cent. If the temperature undergoes a sinusoidal variation of 20°C, calculate the indicated variation in temperature. (4)

2. What will be the nature of response for 1st and 2nd order measuring systems for a step input and draw specific conclusions. (5)

3. Discuss the effects that will occur, when a single active strain gauge in a Wheatstone bridge is positioned on a test structure at a location remote from the bridge. (5)

4. Justify the statement that a potentiometer circuit is inadequate for strain gauge application. (2)

5. A tensile force link is to be made by mounting four strain gauges (each of 120 ohm) on a thin aluminum strip of area 10 mm^2. Gage factor is 2.1. Maximum force applied is 400 N. Maximum current through the gauge is limited to 25 mA. Young's modulus of the strip material is 6.9×10^{10} N/m^2. Suggest a suitable arrangement for getting maximum output from the bridge. Determine output voltage of the bridge and strain in the strip. (4)

6. In a capacitive transducer having three plates, the middle plate is movable and is configured to give a differential output. Prove that the sensitivity (S) is given by S = E/d where E is the applied voltage and d is the distance between two plates of the capacitor. (6)

7. Sketch an amplifier circuit using an operational amplifier for differential amplification. Write down the expression for output. (3)

8. Using suitable graphs explain how a seismic mass instrument can be used to measure vibratory displacement. (3)

9. With the help of a suitable sketch explain how a capacitive transducer made of quartz diaphragms can be used to measure pressure. (3)

10. A variable potential divider has a total resistance of 2 kilo-ohms and is fed from a 10 volts DC supply. The output is connected in a detector circuit having an internal resistance of 5 kilo-ohms. Determine the loading error for the wiper position corresponding to 60 per cent of the full displacement. (3)

11. With suitable graphs illustrate the relationship between resistance and temperature for the following: (i) platinum resistance thermometer; and (ii) thyristor. (2)

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