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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2013

MECHANICAL ENGINEERING

VI Semester

ME 9035 : MEASUREMENT & CONTROLS

(Regulation R 2008)

15

Time: 3 Hours

Answer ALL Questions

Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. What are the characteristics of random error?
2. Define the term static sensitivity in respect of zeroth order system.
3. Why is an uncertainty analysis important in the preliminary stages of experimental planning?
4. Specify the transducer which could be used for the following information change (i) Angular position of a shaft to pulses of light (ii) Displacement to potential difference.
5. List the various methods used for signal / data transmission from the location of measurement.
6. What is a Prony Brake?
7. What are the sources of error in the manometer pressure measurement device?
8. How does a sling psychrometer measure relative humidity?
9. A temperature control system has a set point of 20°C and the measured value is 18°C. What is (a) the absolute deviation, (b) the percentage deviation?
10. Define the term % Proportional band and its significance.

PART – B (5 X 16 = 80 MARKS)

11. (a) Describe various steps involved in the design of measurement and control system. (10)
(b) Suggest a level measurement system that could be part of a level control system for water in a tank. The output from the measurement system is to be an electrical signal to maintain constant level. The water level fluctuates at the depth of 1.5 m and 2 m. The system must be capable of operating continuously and automatically without adjustment for long period of time. (6)
12. a) (i) What is calibration and why it is important for an instrument? (4)
(ii) Grashof Number is a non-dimensional parameter that occurs in free convection problems. It is given by $Gr = (g\beta\Delta TL / \nu^2)$, Where g is the acceleration due to gravity, β is the isobaric compressibility of the medium, ΔT is a characteristic temperature difference in the problem, L is the characteristic length dimension and ν is the kinematic viscosity of the medium. In a certain situation the following data is given:
 $g = 9.81 \text{ m/s}^2$, $\beta = 0.00065\text{K}^{-1}$, $\Delta T = 298 \pm 0.5\text{K}$, $L = 0.05 \pm 0.001\text{m}$,
 $\nu = (14.1 \pm 0.3) \times 10^{-6} \text{ m}^2/\text{s}$. Determine the nominal value of Gr and its uncertainty and outline the methods to reduce the same. (12)

OR

- b) (i) Distinguish between and give appropriate examples in each case: (1) Range and Span (2) Error and accuracy (3) Hysteresis and Dead zone (4) Threshold and resolution and (5) Drift and reproducibility (10)

(ii) A small temperature sensor operates as a first order system and is stated to have time constant of 0.1 s. If it is initially at a temperature of 100°C and suddenly exposed to an environment temperature of 15°C, how long it will take to indicate a temperature of 20°C? (6)

13. a) (i) Describe the principle of operation of a piezo-electric transducer and identify the input and output of the system. (6)

(ii) A Wheatstone bridge circuit used in the strain measurement system comprises four strain gauges of equal magnitude, one connected into each limb of the bridge. The nominal resistance of each gauge is 120 Ω and the bridge supply voltage is 10 V. When strained, the resistance changes by 0.5 Ω . Obtain the relation between output voltage and strain and calculate the output voltage. (10)

OR

- b) Describe the principle of operation of a (i) Cathode ray oscilloscope and (ii) Microprocessor based data logging system

14. a) (i) What are the factors to be considered in the selection of flow meters? (4)

(ii) Find the throat diameter of a venturimeter, when fitted to a horizontal main 10 cm diameter having a discharge of 20 litres per second. Pressure gauges inserted at the entrance and throat indicate pressures of 150 kN/m² and 80 kN/m² respectively. Assume $C_d = 0.98$. If instead of pressure gauges, the entrance and throat of the meter are connected to the two limbs of a 'U' tube mercury manometer, determine the reading in mm of differential mercury column. (12)

OR

- b) (i) Explain the working principle of radiation pyrometer and discuss why emissivity is important in radiation temperature measurement? (10)

(ii) A Saybolt viscometer is used to measure the viscosity of a certain oil. The time for drainage of the standard 60 mL sample is 140 ± 1 s. Calculate the dynamic viscosity of the oil in units of kg/m.s if the density is 880 kg/m³. (6)

15. a) Distinguish between open-loop and closed loop control systems with the help of suitable schematic and identify the system parameters and components in each case also describe a typical close-loop control system to control the following processes (i) the volume flow rate in a pipe arrangement (ii) the speed of an automobile vehicle.

OR

- b) (i) Describe the operation of a magnetic, hydraulic and pneumatic controller. (12)

(ii) A controller gives an output in the range 4 to 20 mA to control the speed of a motor in the range 140 to 600 rev/min. If the motor speed is proportional to the controller output, what will be the motor speed when the controller output is (a) 8 mA, (b) 40%? (4)