OR

For the system whose open-loop transfer function is

$$G(s) = \frac{10}{s(0.2s+1)}$$

Calculate static error constants K_p, K_v and K_a and obtain steady state error, when system is subjected to an input

$r(t) = A_0 + A_1 t$

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Roll No .....

ME - 503

B.E. V Semester

Examination, December 2015

Mechanical Measurement and Control

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each questions are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max.50 words) carry 2 marks, part C (Max.100 words) carry 3 marks, part D (Max.400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

1. a) Define a zero order system.

   b) What is static and dynamic calibration?

   c) Give two advantages of each

      i) Mechanical instruments

      ii) Electrical instruments

      iii) Electric instruments

   d) Give differential equation for a general first order system and derive transfer function for it.

      OR

      Write the general input function for second order system and draw for second order system

      i) Frequency response Vs magnitude ratio

      ii) Frequency response Vs phase shift

2. a) Draw normal distribution curve.

   b) What is regression analysis?

   c) Explain the method to estimate the propagation of error.

   d) A force measuring instrument described by the following data.

   Resolution - 0.25 N

   Range - 0-100 N

   Linearity - within 0.3 N over range

   Repeatability - within 0.4 N over range

   Provide an estimate of the uncertainty attributable to this instrument and the instrument design stage uncertainty.

   OR

   How the Gross, systematic, random errors are minimise. Explain RSS method of combining elemental errors.

3. a) Draw the Wheatstone Bridge circuit for temperature measurement.

   b) What are thermistors? Name some of its commercial forms.

   c) What is the working principle of rotameter?

   d) Describe the construction and working of a venturimeter. Derive the expression for actual flow rate for incompressible fluids.

OR

Calculate the temperature sensitivity of a thermistor at 100°C. Its resistivity at 100°C is 1.1 Ω m. Express the result in Ω m/k. Take $\beta = 4120k$ at 100°C.

4. a) How stress can be measured?

   b) Explain the principle of working of resistance strain gauge.

   c) Draw the diagram of Tachometer generator. Write its two limitations.

   d) Explain the method of measuring torque of rotating shafts using strain gauge.

   OR

   Describe rope brake dynamometer with the help of a neat sketch. Derive the expression for its power and torque.

5. a) Draw the basic structure of a feedback control system.

   b) Compare open and closed loop system.

   c) What is mechanical system? Write down the transfer function for various mechanical system.

   d) A system when excited by unit step function input gave the following response

   $c(t) = 1 - 2e^{-t} + 4e^{-3t}$

   Obtain the transfer function C(s)/R(s)