TE (SEM-V) (REV-2012) NOV 24
CBSGS (MECHANICAL ENGG) 3:00 to 6:00

MECHANICAL MEASUREMENT AND CONTROL

QP Code : 5597

(3 Hours) **[Total Marks : 80**

N.B.:
(1) **Question No.1 is compulsory**
(2) Attempt any **three**questionsout of remaining **five** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary**.
(5) Notations carry usual meaning.

Q.1(A) Explain generalized measurement system elements with block diagram. 05

(B) Write the different classification of control systems. 05

(C) Write short note on PI controller. 05

(D) Write the working principle of piezoelectric accelerometer 05

Q.2(A) Explain the following terms with respect to the measurement system: (i) Span and Range (ii) Hysteresis 06

(B) Illustrate the working principle of "LVDT" for displacement measurement. 06

(C) Convert the following state-space system of a single input single output system into a transfer function: 08

$$\begin{Bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{Bmatrix} = \begin{bmatrix} -3 & 2 \\ 1 & 1 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} + \begin{Bmatrix} 0 \\ 2 \end{Bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix}.$$

Here x_1 and x_2 are state-variables, u (t) is a force vector and y (t) being the system response.

Q.3(A) With a neat sketch explain working of an Operational Amplifier (Op-amp). Enumerate limitations of the same. 05

(B) What are desired, interfering and modifying inputs w.r.t. measurement of a system? 05

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(C) A unity feedback system has $G(s) = \frac{k}{s(1+s)(1+0.4\,s)}$, (a) If r (t) = 4t and k= 2, find steady state error (b) If it is desired to have steady state error to be 0.2 find corresponding value of "k". (c) Find steady state error if input is changed to 2+6t , and value of "k" to 10. 10

Q.4(A) What are rosettes? Explain different types and configuration of rosettes. 10

(B) The open loop T.F. of unity feedback system is $G(s) = \frac{K}{S(1+TS)}$, for this system overshoot reduces form 0.6 to 0.2 due to change in "K" only. Show that $\frac{TK_1 - 1}{TK_2 - 1} = 43.33$, where K_1 and K_2 are values of "K" for 0.6 and 0. 2 overshoot respectively 10

Q.5(A) Sketch Bode plot and assess the stability for the control system having open loop transfer function 10

$$G(S)H(S) = \frac{120}{(S+2)(S+10)}$$

(B) With a neat sketch explain the constructional feature and working of (i) Ionization Gauge, (ii) Thermistors 10

Q.6(A) Draw the root-locus of the control system whose open-loop transfer function is given by

$$G(S)H(S) = \frac{K}{S^2(S+1)}$$ 10

(B) With a neat sketch explain the constructional feature and working of (i) digital tachometer, (ii) Electromagnetic flow meter 10
