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10AE71

Seventh Semester B.E. Degree Examination, Dec.2015/Jan.2016

Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the following briefly :
i) Plants ii) Process iii) System iv) Disturbances v) Feedback control. **(10 Marks)**

b. Explain open loop and closed control systems with an example to each type. **(10 Marks)**

2 a. Obtain the transfer function of field controlled DC Motor. **(10 Marks)**

b. Draw the equivalent mechanical system and analogous systems based on F – V and F – I methods for the system shown in Fig. Q2 (b). **(10 Marks)**

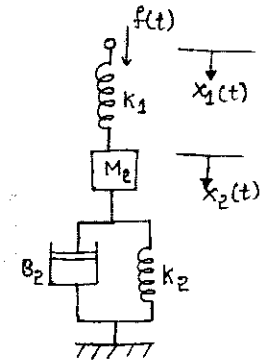

Fig. Q2 (b)

3 a. Reduce the block diagram shown in Fig Q3(a) and obtain its closed loop T.F C(S)/R(S). **(10 Marks)**

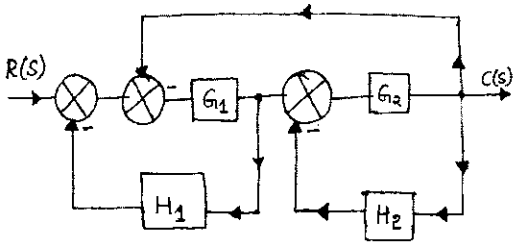

Fig. Q3 (a)

b. Find C(S)/R(S) using Mason's gain formula for the system represented by signal flow graph in Fig. Q3 (b) **(10 Marks)**

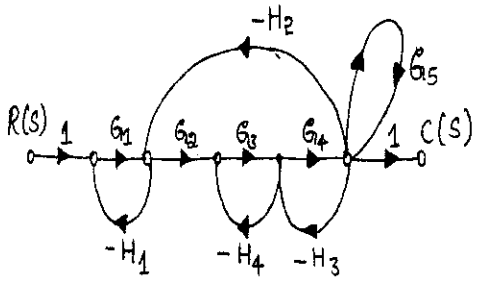

Fig. Q3 (b)

4 a. Explain the following standard test signals :
i) Step I/P ii) Ramp I/P **(04 Marks)**

b. A second order system is given by,
$\frac{C(S)}{R(S)} = \frac{25}{S^2 + 6S + 25}$. Find its rise time, peak time, peak overshoot and settling time if subjected to unit step input. Also calculate expression for its output response. **(08 Marks)**

c. For a system with characteristic equation $F(S) = S^6 + 3S^5 + 4S^4 + 6S^3 + 5S^2 + 3S + 2 = 0$, examine stability. **(08 Marks)**

PART – B

5 a. Explain the concept of Nyquist stability criterion for the stability of control system in frequency domain. **(08 Marks)**

b. The open loop transfer function is $\frac{(S+2)(S+8)}{S^3}$. Is the closed loop system stable? If not, deduce the number of unstable poles. Use the Nyquist criterion to arrive at your answers. **(12 Marks)**

6 For a unity feedback system $G(S) = \frac{800(S+2)}{S^2(S+10)(S+40)}$ Sketch the Bode plot, asymptotic in nature comment on stability. **(20 Marks)**

7 Sketch the root locus of a system having $G(S)\,H(S) = \frac{K}{S(S^2 + 4S + 1)}$

i) What is the range of damping factor for the dominant poles?
ii) What is the angle of departure from complex open loop poles?
iii) For what values of K the system crosses the imaginary axis. **(20 Marks)**

8 a. What is series and feedback compensation? Explain. **(06 Marks)**

b. Consider the system with state equation.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

Estimate the state controllability by ,
i) Kalman's test and ii) Gilbert's test. **(14 Marks)**

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