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10AE71

Seventh Semester B.E. Degree Examination, Dec.2016/Jan.2017
Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Explain the following controllers with their transfer functions :
i) proportional ii) integral
iii) integral proportional iv) proportional integral differential controllers. **(12 Marks)**

b. Explain open loop control system with its advantages and disadvantages. **(08 Marks)**

2 a. Considering small deviations from steady state operation, draw a block diagram of the air heating system shown in Fig. Q2(a).Assume that the heat loss to surroundings and the heat capacitance of the metal parts of the heater are negligible. **(08 Marks)**

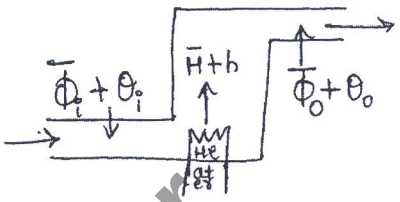

Fig. Q2(a)

b. Determine system equations of the system shown in Fig. Q2(b). Draw f - v and f - i analogies. **(12 Marks)**

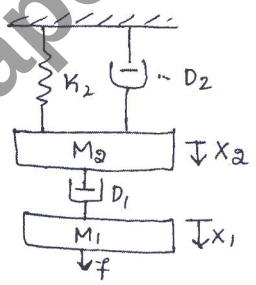

Fig. Q2(b)

3 a. Reduce the block diagram and obtain its loop T.F. C(s)/R(s). **(10 Marks)**

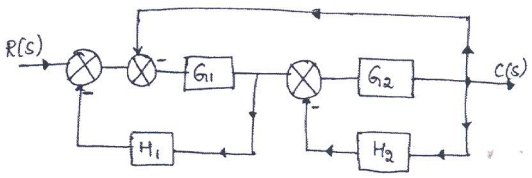

Fig. Q3(a)

b. Find $\frac{C(s)}{R(s)}$. **(10 Marks)**

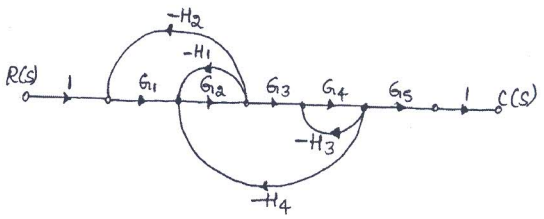

Fig. Q3(b)

4 a. A second order system has unity feedback and open loop transfer function :

$$G(s) = \frac{500}{s(s+15)}$$

i) Draw the block diagram for closed loop system
ii) What is characteristic equation?
iii) What is damping ratio and natural frequency values?
iv) Calculate T_p(peak time), M_p(peak overshoot) and T_s (setting time) for the system output response when excited by unit step input. **(10 Marks)**

b. For a system with characteristic equation :
$F(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$, examine stability. **(10 Marks)**

PART – B

5 a. Define :
i) polar plot
ii) phase margin
iii) gain margin
iv) gain cross over frequency. **(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 Draw the Bode magnitude and phase angle plots for the transfer function :

$$G(s) = \frac{2000(s+1)}{s(s+10)(s+40)}.$$ **(20 Marks)**

7 Sketch the complete root locus for the system having :

$$G(s)H(s) = \frac{k(s+5)}{(s^2+4s+20)}.$$ **(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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