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10ME82

Eighth Semester B.E. Degree Examination, Dec.2017/Jan.2018

Control Engineering

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain regulator and follow-up closed loop control system with examples. **(08 Marks)**

b. What are the requirements of an ideal control system? **(04 Marks)**

c. Explain Proportional controller and Integral controller with block diagrams. **(08 Marks)**

2 a. Obtain differential equations for the mechanical system shown in the Fig.Q2(a). Also draw equivalent force-voltage and force-current circuits using analogues quantities.

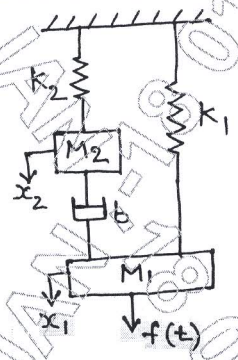

Fig.Q2(a) **(10 Marks)**

b. Fig.Q2(b) shows liquid level system in which q_i is inflow rate, q_0 is out flow rate, R is hydraulic resistance, C is hydraulic capacitance and h is head of liquid. Obtain transfer function $\frac{Q_o(s)}{Q_i(s)}$.

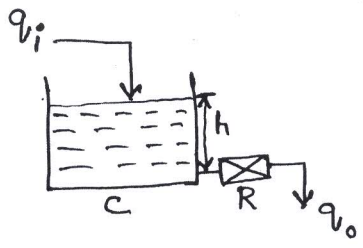

Fig.Q2(b) **(06 Marks)**

c. Obtain differential equation for RLC circuit. **(04 Marks)**

3 a. Obtain closed loop transfer function of the block diagram shown in Fig.Q3(a) using block diagram reduction techniques.

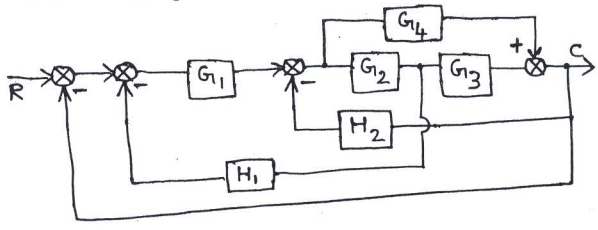

Fig.Q3(a) **(10 Marks)**

b. Draw signal flow graph for the system shown in Fig.Q3(b) and find $\frac{C}{R}$ using Mason's gain formula.

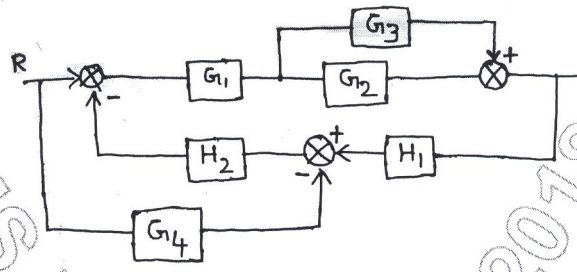

Fig.Q3(b) **(10 Marks)**

4 a. Obtain response equation for a first order mechanical system subjected to unit step input. **(08 Marks)**

b. Define the following terms:
i) Rise time ii) Delay time
iii) Settling time iv) Maximum overshoot **(04 Marks)**

c. Using RH criteria determine the stability of a system whose characteristic equation is given by $s^5 + 4s^4 + 3s^3 + 12s^2 + 5s + 20 = 0$. **(08 Marks)**

PART – B

5 Plot the Nyquist diagram for the open loop transfer function $G(s)H(s) = \frac{12}{s(s+1)(s+2)}$ and determine the nature of stability. **(20 Marks)**

6 The open loop transfer function of a certain unity feedback system is $G(s) = \frac{K}{s(s+2)(s+20)}$, construct Bode plots and determine:
i) Limiting value of K for system to be stable.
ii) Value of K for gain margin to be 10 db.
iii) Value of K for phase margin to be 50°. **(20 Marks)**

7 a. Sketch Root Locus plot for the unity feedback system whose open loop transfer function is given by $G(s) = \frac{K(s+1)}{s^2}$. Discuss on stability of system. **(14 Marks)**

b. Explain the effect of addition of poles and zero's to the system. **(06 Marks)**

8 a. A system is represented by a differential equation $\dddot{y} + 6\ddot{y} + 12\dot{y} + 10y = 4U$, where y is the output and U is the input of the system. Obtain state space equation. **(06 Marks)**

b. Find controllability and observability of the system shown in Fig.Q8(b) using Kalman test.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -6 & 2 & -4 \\ -18 & 3 & -8 \\ -6 & 1 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 \\ 3 \\ 1 \end{bmatrix} u(t)$$

Fig.Q8(b) **(06 Marks)**

c. Write notes on:
i) Lag compensator
ii) Lead compensator. **(08 Marks)**

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