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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. (10 Marks)

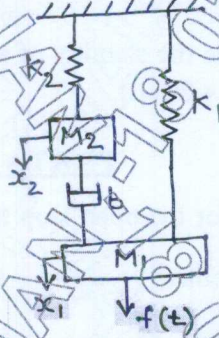


Fig.Q2(a)

(10 Marks)

- b. Fig.Q2(b) shows liquid level system in which  $q_i$  is inflow rate,  $q_o$  is out flow rate,  $R$  is hydraulic resistance,  $C$  is hydraulic capacitance and  $h$  is head of liquid. Obtain transfer function  $\frac{Q_o(s)}{Q_i(s)}$ . (06 Marks)

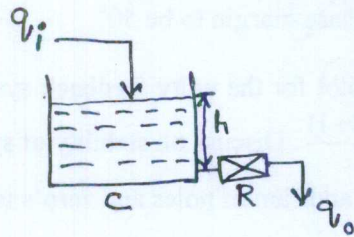


Fig.Q2(b)

(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. (10 Marks)

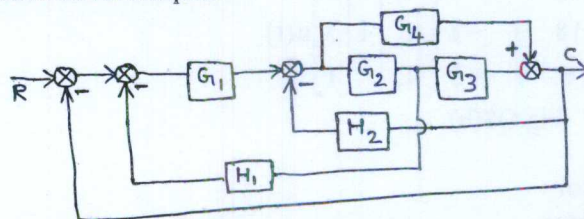


Fig.Q3(a)

(10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.



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

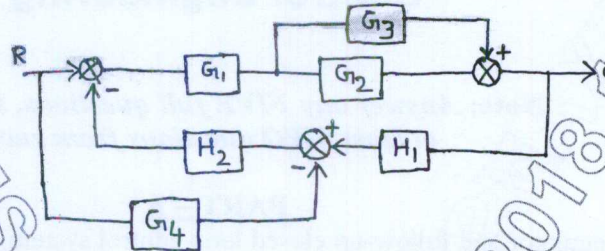


Fig.Q3(b)

(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:
- Rise time
  - Delay time
  - Settling time
  - 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:
- Limiting value of K for system to be stable.
  - Value of K for gain margin to be 10 db.
  - Value of K for phase margin to be  $50^\circ$ .
- (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  $\ddot{y} + 6\dot{y} + 12y + 10y = 4U$ , 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:
- Lag compensator
  - Lead compensator.

(08 Marks)

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