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08MAR22

Second Semester M.Tech. Degree Examination, December 2010
Modern Control Engineering

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. ***Missing data, if any, may be suitably assumed.***

1 a. Explain the terms: i) System ii) Disturbances iii) Transform function iv) Open loop control system v) Block diagram. **(10 Marks)**

b. Explain, giving equations, the functions of, i) Integral control ii) Proportional plus derivative control. **(10 Marks)**

2 Sketch the root locus for the open loop transfer function,

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

Discuss the stability of the system as a function of K. **(20 Marks)**

3 A unity feedback control system has, $G(s) = \frac{80}{s(s+2)(s+20)}$.

Draw the bode plot and determine
i) Gain and phase margins.
ii) Gain crossover and phase crossover frequencies.
Comment on the stability. **(20 Marks)**

4 a. Write a note on M and N circles. **(06 Marks)**

b. Sketch the polar plot for a system with $G(s)H(s) = \frac{10}{s(s+1)(s+2)}$. Calculate gain margin and hence comment on its stability. **(14 Marks)**

5 a. Draw the Nyquist plot for $G(s)H(s) = \frac{40}{(s+4)(s^2+2s+2)}$ **(10 Marks)**

b. Write short notes on: i) Lag compensation ii) Lead compensation. **(10 Marks)**

6 a. A feedback system has the closed loop transfer function, $\frac{Y(s)}{U(s)} = \frac{\delta}{s^3+3s^2+7s+9}$. Construct a state model. **(06 Marks)**

b. Determine the transfer function of the system having the state model,

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} u(t); \quad y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$ **(06 Marks)**

c. A control system is described by,

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

Determine if the system is completely controllable and observable. **(08 Marks)**

7 a. Define z-transform. **(02 Marks)**

b. Find the transient and steady state response of a mechanical control system represented by the equation, $0.5\frac{dy}{dt} + 8y = 8 \times 6t$, taking y(0)=0. **(08 Marks)**

c. Using the block diagram reduction technique, find the closed loop transfer function of the system shown in figure Q7 (c). **(10 Marks)**

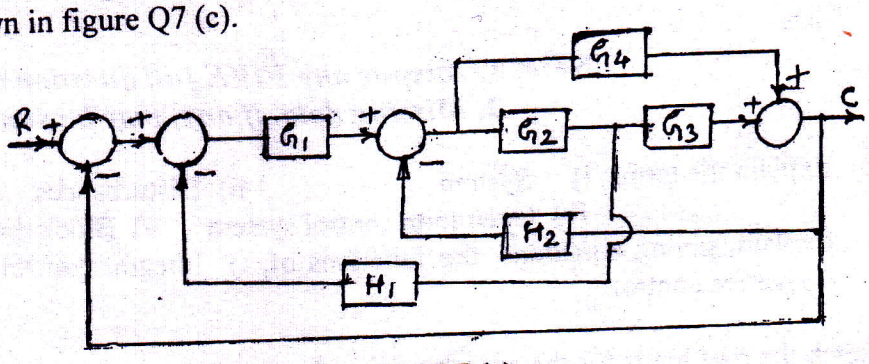

Fig.Q7 (c)

8 Write short notes on:

a. Sampled-data control system.

b. Computer-controlled system.

c. State transition matrix.

d. Gain margin and phase margin. **(20 Marks)**

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