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10MAR22

Second Semester M.Tech. Degree Examination, June 2012
Modern Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Derive equation of motion for mechanical system subjected to a unit step input and obtain the response of the system for critical damped system. **(10 Marks)**

b. The characteristic equation of a feed back control system is given by $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. Find the stability of the system. **(10 Marks)**

2 Sketch the root locus plot for a negative feed back control system characterized by an open loop transfer function $G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+20)}$ for all values of 'K' ranging from 0 to ∞. **(20 Marks)**

3 Sketch the bode plot for the transfer function $G(s)H(s) = \frac{K(1+0.2s)(1+0.025s)}{s^2(1+0.001s)(1+0.005s)}$. **(20 Marks)**

4 a. Show that for open loop transfer function of the type $\frac{1}{(1+jwT_1)(1+jwT_2)}$ the polar plots cut the imaginary axis at $w = \frac{1}{\sqrt{T_1T_2}}$ and its magnitude is $\frac{\sqrt{T_1T_2}}{T_1+T_2}$. **(12 Marks)**

b. Plot the general shapes of polar plots of the following transfer function indicating the magnitude at W = 0, ∞ : i) $\frac{1}{1+jwT_1}$; ii) $\frac{1}{jw(1+jwT_2)}$. **(08 Marks)**

5 a. Draw the Nyquist plot and examine the stability of the closed loop system whose open loop transfer is $G(s)H(s) = \frac{s+2}{(s+1)(s-1)}$. **(10 Marks)**

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

6 a. Obtain the state space representation of system shown in Fig.Q.6(a). **(10 Marks)**

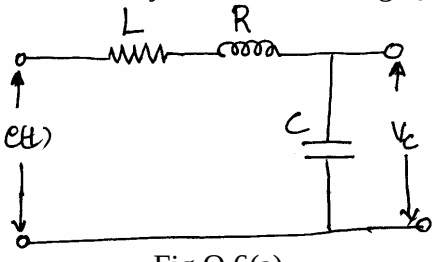

Fig.Q.6(a)

b. Find the controllability and observability of the system using Kalman test.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 2\end{bmatrix}u.$$ **(10 Marks)**

7 a. Explain with neat sketch, computer controlled system, obtain its controller characteristics. **(10 Marks)**

b. Explain direct digital control with a typical example. **(10 Marks)**

8 Write short notes on :

a. Characteristic equation.

b. Signal flow graph.

c. Nyquist stability criteria.

d. Requirements of control system. **(20 Marks)**

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