T.E (Electrical) Sem-VI CBGS

Q.P. CODE: 38390

7/12/18

1/3

Time: 3 Hours **Marks: 80**

Note:

- Question No. 1 is compulsory.
- Answer any **three** from the remaining five questions.
- Assume suitable data if necessary and justify the same.

Q. 1 **Answer any FOUR of the following** 20

a. What is the significance of gain margin and phase margin of a system?

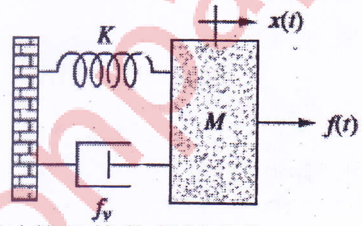
b. Define break-away point and break-in point in root locus plot of a system.

c. Represent the given system in phase variable form of state space representation. Also draw SFG.

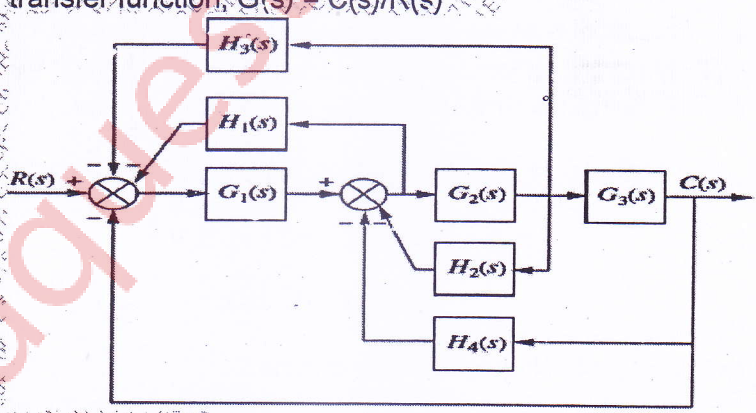
$$G(s) = \frac{s^2 + 35s + 120}{(s+8)(s+9)(s+7)}$$

d. Compare open loop and closed loop control systems with the help of suitable example.

e. Obtain series electrical analog of the following system.



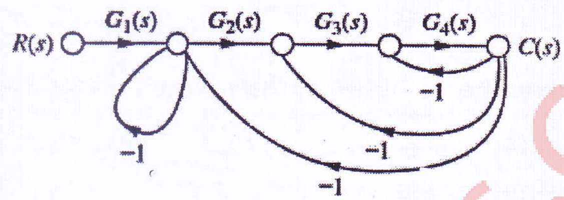
Q.2 a. Reduce the block diagram shown below to a single block representing the transfer function, G(s) = C(s)/R(s) 10



b. Draw Bode plot for the following unity feedback system, determine ω_{gc}, ω_{pc}, PM, GM and comment on the stability of the system. 10

$$G(s) = \frac{(s+3)}{(s+2)\,(s^2+2s+25)}$$

Q.3 a. Using Mason's rule, find the transfer function, G(s)=C(s)/R(s) for the system represented by 10



b. Given the system represented in state space as follows: 10

$$\dot{x} = \begin{bmatrix} \text{[illegible]} & -1 & 1 \\ 2 & 1 & 3 \\ -2 & -1 & -3 \end{bmatrix} x + \begin{bmatrix} 7 \\ 1 \\ -2 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & -3 & 4 \end{bmatrix} x$$

Convert the system to one where the new state vector, z is

$$z = \begin{bmatrix} 4 & -1 & 0 \\ 2 & 3 & -2 \\ 8 & 5 & 1 \end{bmatrix} x$$

Q.4 a. For the following unity feedback system, using Routh Hurwitz criteria determine the range of K to ensure stability. What should the value of K for the system response to oscillate, and determine the frequency of oscillation. 10

$$G(s) = \frac{K(s^2+1)}{(s+1)(s+2)}$$

b. Obtain Laplace transform solution of the following system. Consider unit step signal as input to the system 10

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} x + \begin{bmatrix} 10 \\ 0 \\ 0 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x$$

Q.5 a. Derive and explain Nyquist stability criteria. 10

b. For each pair of second order system specifications that follows, find the location of the second order pair of poles. 10

a. %OS = 15%; Ts=0.6 sec

b. %OS = 10%; Ts=4 sec

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Q.6 a. A unity feedback system has an open-loop transfer function 10

$$G(s) = \frac{K(s+1)}{s(s-1)}$$

Sketch the root locus and determine the range of K for the system to be stable.

b. A unity feedback system has the following forward path transfer function: 10

$$G(s) = \frac{1000(s+8)}{(s+7)(s+9)}$$

a. Evaluate system type, K_p, K_v and K_a.

b. Use answer in (a) to find steady state errors for standard step, ramp and parabolic inputs.

c. Explain how many integrations in the forward path are required to get zero steady state error for standard step, ramp and parabolic inputs.

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