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C028514(028)

B. Tech. (Fifth Semester) Examination Nov.-Dec. 2021

(ET & T Engg. Branch)

CONTROL SYSTEM

Time Allowed : Three hours

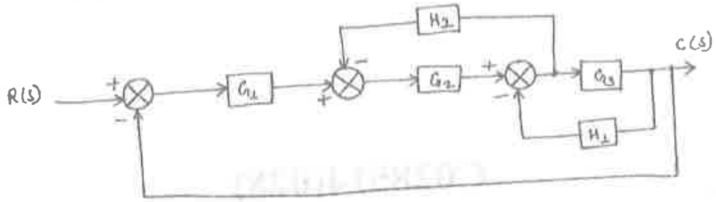
Maximum Marks : 100

Minimum Pass Marks : 35

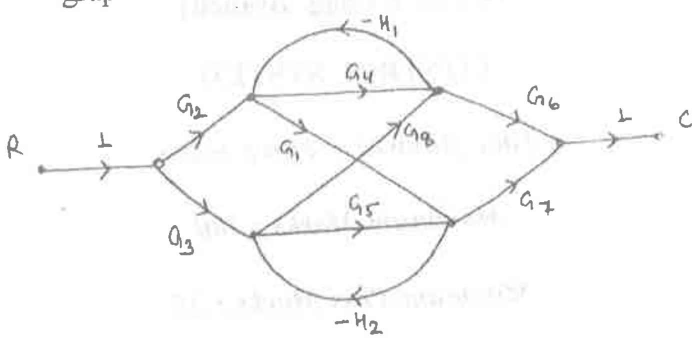
Note : *Attempt all questions. Part (a) from each question is compulsory and answers any two of the remaining (b), (c) and (d).*

1. (a) Define closed loop system. 4

(b) Find the ratio $C(s)/R(s)$ of the system shown in figure. 8



(c) Obtain the transfer function C/R from signal flow graph shown in figure. 8



(d) Write the comparision between open loop system and close loop system. 8

2. (a) Write the expression for transfer function of a second order control system. 4

(b) Calculate the time response of second control system subjected to unit step input function. 8

(c) For a unity feedback control system the forward path transfer function is given by :

$$G(s)=\frac{20}{s(s+2)(s^2+2s+20)}$$

Determine the steady state error of the system when the inputs are :

(i) 5

(ii) $5t$

(iii) $\frac{3t^2}{2}$ 8

(d) The overall transfer function of a control system is given by : 8

$$\frac{C(s)}{R(s)}=\frac{16}{s^2+1\cdot 6s+16}$$

It is desired that the damping ratio be 0·8. Determine the derivative rate feedback constant K_t and compare rise time, peak time, maximum overshoot and steady state error for unit ramp input without and with derivative feedback control.

3. (a) Define relative stability. 4

(b) A closed loop system, has characteristics equation gives by : 8

$$s^5 + 2s^4 + 2s^3 + 4s^2 + 11s + 10 = 0$$

Find the stability using Routh Hurwitz criterian.

(c) The characteristics equation of feedback control system is : 8

$$s^4 + 20s^3 + 15s^2 + 2s + k = 0$$

(i) Determine the range of k for the system to be stable.

(ii) Can the system be marginally stable? If so, find the required value of k and the frequency of sustained oscillation.

(d) For a unity feedback system the open loop transfer function is given by

$$G(s) = \frac{k}{s(s+2)(s^2+6s+25)}$$

(i) Sketch the root locus for $0 \le k \le \infty$

(ii) At what value of 'k' the system becomes unstable. 8

4. (a) What are the advantages of frequency domain. analysis? 4

(b) Sketch the polar plot for : 8

$$G(s) = \frac{20}{s(s+1)(s+2)}$$

(c) Sketch the bode plot for the transfer function 8

$$G(s) = \frac{1000}{(1+0\cdot1s)(1+0\cdot001s)}$$

Determine the :

(i) phase margin

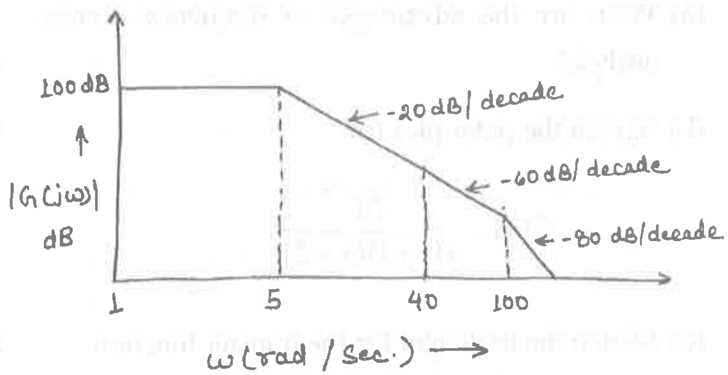
(ii) gain margin

(iii) the system is inherently stable

(d) The magnitude plot of the open loop transfer function $G(s)$ of a certain system shown in figure. 8

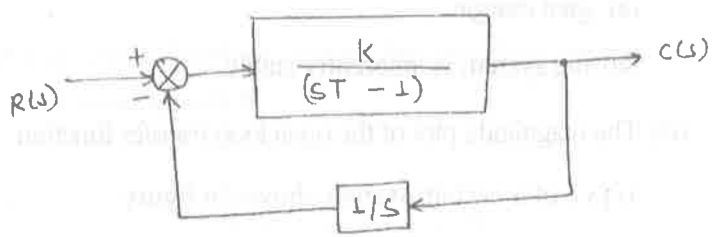
(i) Determine $G(s)$ if it is known that system is of minimum phase type.

(ii) Estimate the phase at each of the corner frequencies.



5. (a) Define state variable and state vector. 4

(b) A closed loop control system is described by the block diagram given below, determine the stability using Nyquist criterion. 8



(c) The transfer function of a control system is given by : 8

$$\frac{Y(s)}{U(s)} = \frac{s+2}{s^3 + 9s^2 + 26s + 24}$$

Check for controllability and observability.

(d) Use diagonalization of matrix A to determine the time response of the system : 8

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \text{ and}$$

$$Y = \begin{bmatrix} 6 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \text{; given that, } x(0) = \begin{bmatrix} L \\ 0 \end{bmatrix}$$