Govt. Polytechnic College
Bhilwara

I^st Mid-term

Paper Code : EE 305

Ans1 Explain the following terms:

(i) Transfer function (ii) Type and Order of System.

(iii) Characteristic Equation (iv) Open and Closed loop Control System.

(1X4) marks

Ans2 Find the range of K for which the system is stable whose characteristic equation is

$$s^3 + 3Ks^2 + Ks + 4 = 0$$

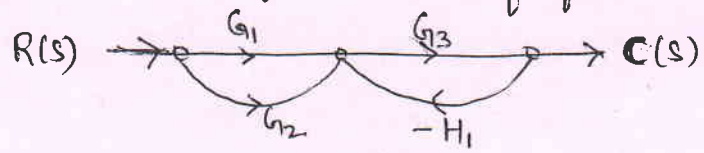
(4) marks

Ans3 Find the static error coefficient for following unity feedback transfer function.

$$G(s) = \frac{80(s+2)}{s(s^2+4s+10)}$$

(4) marks

Ans Find the transfer function of following system.



(3) marks.

Paper Code: 305 Solution

Ans 1 (i) Transfer Function

Laplace transform of Output variable तथा Laplace transform of input variable के अनुपात को Transfer function कहते हैं।

$$T(s) = \left.\frac{C(s)}{R(s)}\right|_{\text{Initial Condition} = 0}$$

(ii) Type of System

Open loop transfer function के जितने number of pole Origin पर होते हैं उससे system का Type ज्ञात होता है।

Order of System

Characteristic equation में s के उच्चतम मान को Order of system कहते हैं।

(iii) Characteristic Equation

Closed loop transfer function के denominator part को zero के बराबर करने पर जो equation प्राप्त होती है उसे characteristic equation कहते हैं।

(iv) ~~Open loop transfer function~~

(iv) Open loop Control system.

जिस system में feedback present न हो उस system को open loop control system कहते हैं।

Closed loop Control system.

जिस system में output और input के मध्य feedback present हो उस system को closed loop system कहते हैं।

Ans 2 Characteristic equation is given

$$s^3 + 3ks^2 + ks + 4 = 0$$

Routh Array is

s^3	1	k
s^2	3k	4
s^1	$\frac{3k^2 - 4}{3k}$	
s^0	4	

Stable system के लिए

$$\frac{3K-4}{3K} > 0$$

$$3K^2 > 4$$

$$K > \frac{2}{\sqrt{3}}$$

और $3K > 0$

$K > 0$

Stable system के लिए K की Range

$$0 < K < \frac{2}{\sqrt{3}}$$

Ans 3 Given $G(s) = \frac{80(s+2)}{s(s^2+4s+10)}$

$H(s) = 1$

Static error Coefficients

① Position Error Coefficient $K_p = \lim_{s\to 0} G(s)H(s)$

$$K_p = \lim_{s\to 0} \frac{80(s+2)}{s(s^2+4s+10)} \times 1 = \infty$$

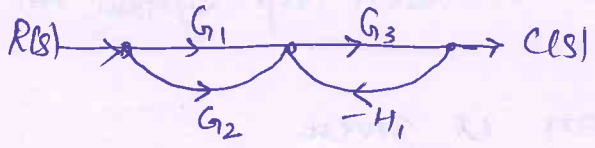
② Velocity Error Coefficient $K_v = \lim_{s\to 0} sG(s)H(s)$

$$K_v = \lim_{s\to 0} s \frac{80(s+2)}{s(s^2+4s+10)} \times 1 = 16$$

③ Acceleration Error Coefficient $K_a = \lim_{s\to 0} s^2 G(s)H(s)$

$$K_a = \lim_{s\to 0} s^2 \frac{80(s+2)}{s(s^2+4s+10)} \times 1 = 0$$

Ans 4



Forward Path

$P_1 = G_1G_3$ $\quad \Delta_1 = 1$

$P_2 = G_2G_3$ $\quad \Delta_2 = 1$

Individual loop

$L_1 = -G_3H_1$

$\Delta = 1 - (L_1) + 0 = 1 + G_3H_1$

Manson's Gain formula

$$T(s) = \frac{\sum_{K=1}^{n} P_K \Delta_K}{\Delta}$$

$$T(s) = \frac{P_1\Delta_1 + P_2\Delta_2}{\Delta}$$

$$T(s) = \frac{G_1G_3 + G_2G_3}{1 + G_3H_1}$$