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Branch: Electrical

II nd Mid Term Exam

III year

Paper Code: EE 305

Ans 1 Derive the formulae of steady state error.

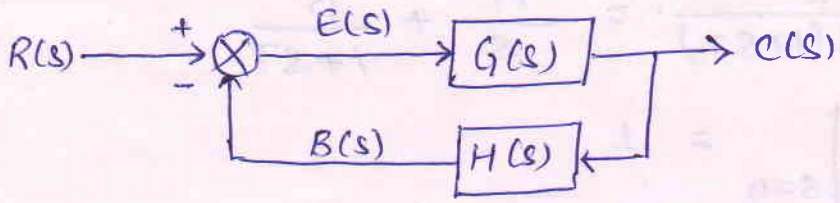
Ans 2 Explain the time response of first order system with unit step input.

Ans 3 Find the range of K for which the system is stable for characteristic equation of feedback control system is

$$5s^3 + Ks^2 + 4s + 1 = 0$$

Solution of Paper
Code EE205

Ans 1



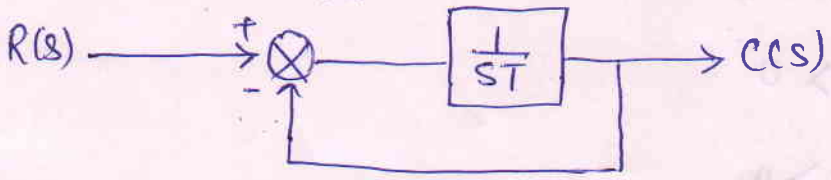
From figure, $B(s) = C(s)H(s)$ and $C(s) = E(s)G(s)$

$$E(s) = R(s) - B(s)$$
$$= R(s) - C(s)H(s)$$
$$E(s) = R(s) - E(s)G(s)H(s)$$
$$E(s)\left(1 + G(s)H(s)\right) = R(s)$$
$$E(s) = \frac{R(s)}{1 + G(s)H(s)}$$

Steady state error is

$$e_{ss} = \lim_{s \to 0} sE(s)$$
$$e_{ss} = \lim_{s \to 0} s\frac{R(s)}{1 + G(s)H(s)}$$

Ans 2 Consider a first order system with unity feedback as shown in figure



using closed loop transfer function formuleg we get

$$\frac{C(s)}{R(s)} = \frac{\frac{1}{ST}}{1 + \frac{1}{ST}}$$

$$\frac{C(s)}{R(s)} = \frac{1}{1 + ST}$$

$$\frac{C(s)}{R(s)}\,E(s) = \frac{R(s)}{1 + ST}$$

Since input is unit step function

$$R(s) = \frac{1}{s}$$

$$\therefore \quad C(s) = \frac{1}{s(1+sT)} \cdot = \frac{A}{s} + \frac{B}{1+sT}$$

$$A = s \cdot \frac{1}{s(1+sT)}\bigg|_{s=0} = 1$$

$$B = (sT+1) \cdot \frac{1}{s(1+sT)}\bigg|_{s=-\frac{1}{T}} = -T$$

$$C(s) = \frac{1}{s} - \frac{T}{1+sT}$$

$$C(s) = \frac{1}{s} - \frac{1}{s+\frac{1}{T}}$$

Taking inverse laplace transform

$$C(t) = 1 - e^{-t/T}$$

Ans3 Routh's Hurwitz table

s^3	5	4
s^2	K	1
s^1	$\frac{4K-5}{K}$	
s^0	1	

For stable system.

$$\frac{4K-5}{K} > 0$$

$$4K-5 > 0$$

$$K > \frac{5}{4}$$