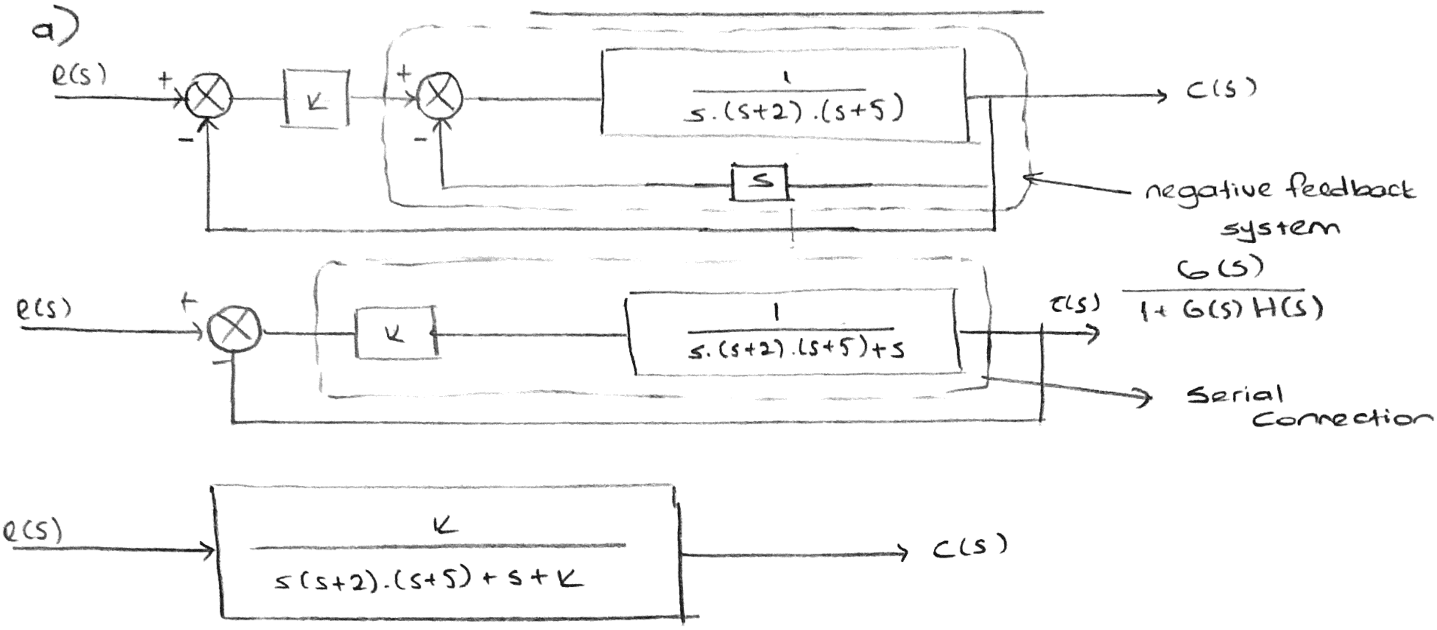
EEEN 352 - QUIZ 03

1)

a)



$$\boxed{\frac{C(s)}{R(s)} = \frac{K}{s^3+7s^2+11s+K}}$$

From the obtained T.F., the characteristic eqn. is

$$s^3+7s^2+11s+K=0$$

The Routh-table;

s^3	1	11
s^2	7	K
s^1	$\frac{77-K}{7}$	
s^0	K	

$$\underbrace{\frac{77-K}{7} > 0 \ \& \ K > 0}$$

$$0 < K < 77$$

So, the range of K for the system to be stable is $0<K<77$

$$E(s) = \frac{s.(s^2+7s+11)}{s^3+7s^2+11s+K} R(s)$$

The steady error is given by; $\quad e_{ss}(t) = \lim_{s\to 0} \frac{s^2.(s^2+7s+11)}{s^3+7s^2+11s+K} R(s)$

Type of input	Steady-State Error
Step input $\left(R(s)=\frac{1}{s}\right)$	0
Ramp Input $\left(R(s)=\frac{1}{s^2}\right)$	$\frac{11}{K}$
Parabolic Input $\left(R(s)=\frac{1}{s^3}\right)$	∞

From the table above, we can clearly say that the type of system is $\boxed{\text{Type-1.}}$

b) $G(s)$ for $K=22$;

$$\frac{22}{s(s+2)(s+5)+s+22}$$

Step Input $= 1.5\,u(t)$

$$e_{ss} = \frac{A}{1+K_p} \qquad A = 1.5$$

$$K_p = \lim_{s\to 0} G(s) = \lim_{s\to 0} \frac{22}{\cancel{s(s+2)(s+5)+s}+22} = 1$$

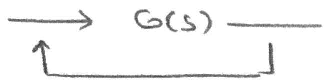
$$\boxed{e_{ss} = \frac{1.5}{1+1} = 1.5/2 = 3/4 = 0.75}$$

c) Ramp $1.5\,u(t)$ $\qquad A = 1.5$

$$e_{ss} = \frac{A}{K_v} \qquad K_v = \lim_{s\to 0} s\,G(s) = \lim_{s\to 0} \frac{22.s}{s(s+2)(s+5)+s+22} = \frac{0}{22} = 0$$

$$\boxed{e_{ss} = \frac{1.5}{0} = \infty}$$

2)

a) 

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

$$\frac{\dfrac{K(s+2)}{s(s-1)}}{1 + \dfrac{K(s+2)}{s(s-1)}} = \frac{K(s+2)}{s(s-1) + K(s+2)} = \frac{K(s+2)}{s^2 - s + Ks + 2K} = \frac{K(s+2)}{s^2 + s(-1+K) + 2K}$$

LHP	s^2	1	$2K$
LHP	s^1	$K-1$	0
LHP	s^0	A	0

$$A = \frac{2K.(K-1) - 0}{K-1} > 0$$

$2K > 0$

$K > 0$ and $K - 1 > 0$

$K > 1$

so, $\boxed{K > 1.}$

b)

number of poles ; $n = 2$ i.e. $P_1 = 0$, $P_2 = 1$

number of series ; $m = 1$ i.e. $z_1 = -2$