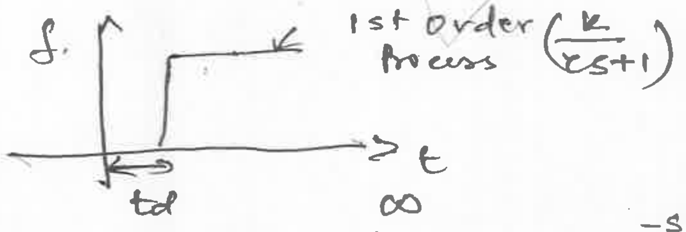
(1) QP - 24637

Q. No. Marks

Q.1

c)



$$\mathcal{L}\{f(t-td)\} = \int_0^\infty f(t-td)\, e^{-st} \cdot dt$$

$$= e^{-s\,td} \int_0^\infty f(t-td) \cdot e^{-s(t-td)} \cdot d(t-td).$$

Let $t - td = u$ then

$$= e^{-s \cdot td} \int_{-td}^{\infty} f(u) \cdot e^{-s \cdot u} \cdot du$$

$$= e^{-s \cdot td} \cdot f(s)$$

$$F(s) = \frac{k}{\tau s+1}$$

$$\therefore \quad = e^{-tds} \cdot \frac{k}{\tau s+1}$$

Pade' Approx. (1st order) $e^{-tds} \approx \dfrac{1-\frac{td}{2}s}{1+\frac{td}{2}s}$

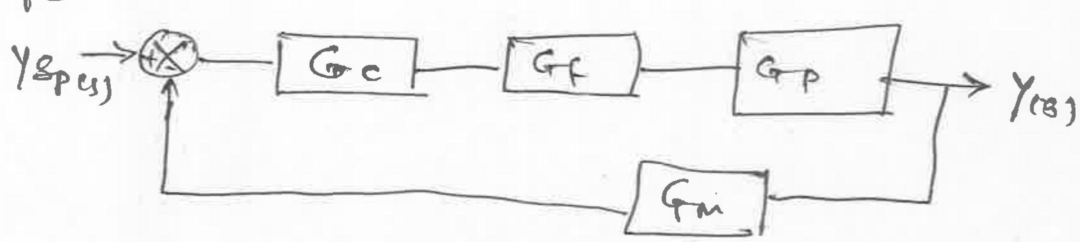
Pade Approx. 2nd order $\dfrac{(td)^2 s^2 - 6tds + 12}{td^2 s^2 + 6tds + 12}$

Q5.

b. Assume

$$G_p = \frac{k_p}{\tau_p s+1}, \quad G_f = G_m = 1 \quad G_c = k_c$$

$\therefore$



$$\frac{Y(s)}{Y_{sp}(s)} = \frac{G_c G_f G_p}{1 + G_c G_f G_p G_m}$$

$$Y(s) = \frac{k_c \cdot (1) \cdot \frac{k_p}{\tau_p s+1}}{1 + k_c(1) \cdot \frac{k_p}{\tau_p s+1} \cdot (1)} Y_{sp}(s)$$

$$= \frac{k_c k_p}{k_c k_p + \tau_p s + 1} Y_{sp}(s)$$

$$= \frac{k_c k_p}{\tau_p s + k_c k_p + 1} Y_{sp}(s)$$

for comparing with $\frac{k}{\tau s+1}$

divide by $k_c k_p + 1$

$$\therefore \frac{\frac{k_c k_p}{k_c k_p + 1}}{\frac{\tau_p}{k_c k_p+1} s + 1} Y_{sp}(s)$$

$$k = \frac{k_c k_p}{1 + k_c k_p} \qquad \tau_p = \frac{\tau_p}{k_c k_p + 1}$$

$\lim_{s \to 0} s \cdot Y(s)$ for unit step : $Y_{sp}(s) = 1/s$

$$= s \cdot \frac{k}{\tau s + 1} \cdot \frac{1}{s}$$

Ultimate $= k$

Ultimate o/p $= k$

Offset $= 1 - k \Rightarrow \frac{1}{1 + k_c k_p}$

03

Q. No. | Marks

Q.6 P

b) $k_p = 1\%/\%$, $k_I = 1\%/\%s$, $k_D = 1\%/\%/s$

for ~~kp~~ P

Control O/P $C(O) = k_p e_p + P(0)$

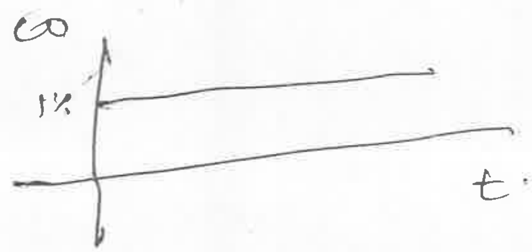
Assume $P(O) = 0\%$

$\therefore \quad CO = k_p e_p$

$e_p = 1\%$

$k_p = 1\%$

$CO = 1\%$

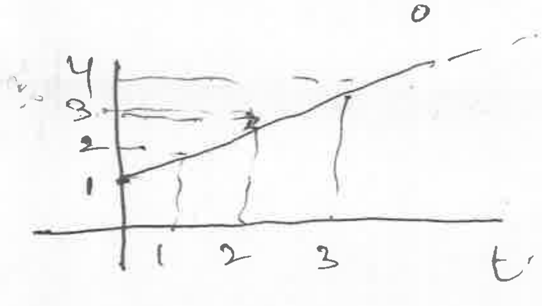


for PI

$$CO = k_p e_p + k_p k_i \int_0^t e_p\,dt + P_I(0)$$

Assume $P_I(O) = 0$

$$1.(1) + (1)(1).\int_0^1 (1)\,dt + \int_1^t dt + 0$$



for PD

$$C_o = k_p e_p + k_p k_D \cdot \frac{de_p}{dt} + P(0)$$

Assume $P(0) = 0$

$$(1)(1) + 1\cdot(1)\cdot \frac{d(1)}{dt} + 0$$

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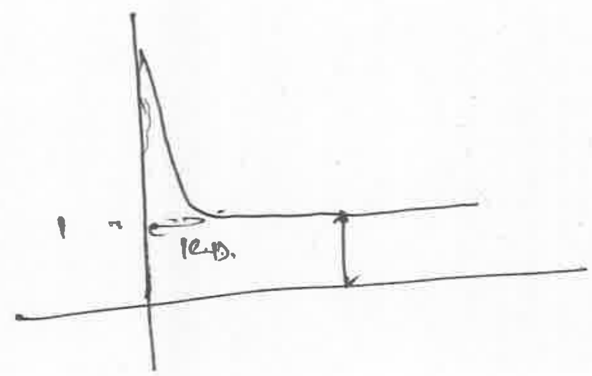

for PID

$$C_o = k_p e_p + k_p k_i \int_0^t e_p dt + k_p k_D \frac{de_p}{dt} + P_I(0)$$

Assume $P_I(0) = 0$

$$(1)(1) + (1)(1)\cdot \int_0^t 1\cdot dt + (1)(1)\frac{d(1)}{dt} + 0$$

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