SHUBHAM GUPTA 180749

QUIZ-3

1) $\tau_I = 3$ cancel dom. pole

$K_c \to$ critically damped.

a) $\boxed{\tau_I = 3 \text{ min}}$

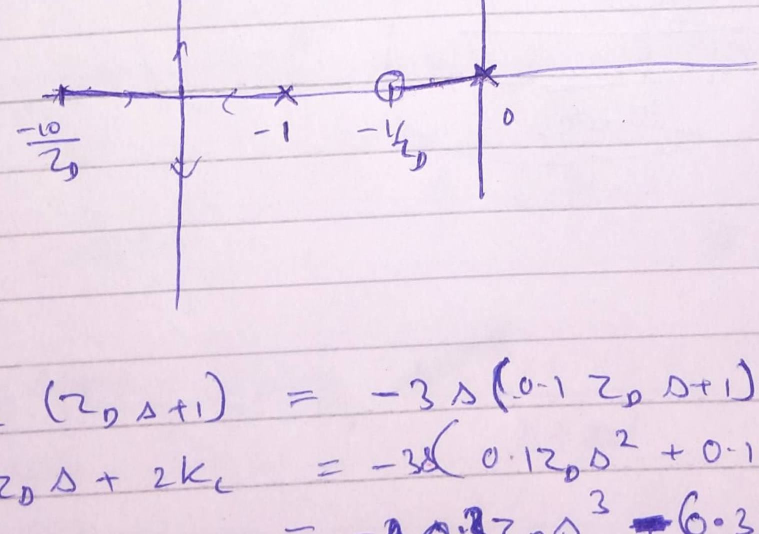
b), c) $G_P = \dfrac{2}{(s+1)(3s+1)}$

CLCE : $1 + K_c\left[\dfrac{\cancel{3s+1}}{3s}\right]\left[\dfrac{(\tau_D s+1)}{(0.1\tau_D s+1)}\right]\dfrac{2}{(s+1)\cancel{(3s+1)}} = 0$

$1 + \dfrac{2K_c(\tau_D s+1)}{3s(0.1\tau_D s+1)(s+1)} = 0.$

root locus of $\dfrac{(\tau_D s+1)}{s(0.1\tau_D s+1)(s+1)}$

zero $-\dfrac{1}{\tau_D}$, $0, -1, -\dfrac{10}{\tau_D}$ poles



$2K_c(\tau_D s+1) = -3s(0.1\tau_D s+1)(s+1)$

$2K_c\tau_D s + 2K_c = -3s(0.1\tau_D s^2 + 0.1\tau_D s + s + 1)$

$= -0.3\tau_D s^3 - (0.3\tau_D + 3)s^2 - 3s$

$0.3\tau_D s^3 + (0.3\tau_D + 3)s^2 + (2K_c\tau_D + 3)s + 2K_c = 0$ α, α, β

— CLCE

$$s^3 + \frac{0.3\tau_D + 3}{0.3\tau_D} s^2 + \frac{2K_c\tau_D + 3}{0.3\tau_D} s + \frac{2K_c}{0.3\tau_D} = 0 \quad \alpha, \alpha, \beta$$

$$2\alpha + \beta = -\frac{(0.1\tau_D + 1)}{0.1\tau_D}.$$

$$\alpha^2\beta = -\frac{2K_c}{0.3\tau_D}$$

$$\alpha^2 + \alpha\beta + \alpha\beta = \alpha(\alpha + 2\beta) = \frac{2K_c\tau_D + 3}{0.3\tau_D}$$

$$3s^2 + 2\left(\frac{0.1\tau_D + 1}{0.3\tau_D}\right) s + \frac{2K_c\tau_D + 3}{0.3\tau_D} = 0 \quad \alpha, \gamma$$

$$\boxed{D = 0}$$

$$\cancel{4}\,\frac{(0.1\tau_D + 1)^2}{(0.3\tau_D)^{\cancel{2}}} - 4\left(\frac{2K_c\tau_D + 3}{\cancel{0.3\tau_D}}\right) = 0$$

$$\frac{0.01\tau_D^2 + 0.2\tau_D + 1}{0.3\tau_D} - 8K_c\tau_D - 12 = 0.$$

$$0.01\tau_D^2 + 0.2\tau_D + 1 - 2.4K_c\tau_D^2 - 3.6\tau_D = 0.$$

$$\boxed{(0.01 - 2.4K_c)\tau_D^2 - 3.4\tau_D + 1 = 0.} \quad \text{in } K_c \text{ \& } \tau_D$$

$$-a^3 j - \left(\frac{0.3\tau_D + 3}{0.3\tau_D}\right) a^2 + \frac{2K_c\tau_D + 3}{0.3\tau_D} a j + \frac{2K_c}{0.3\tau_D} = 0$$

$$-a^2 + \left(\frac{2K_c\tau_D + 3}{0.3\tau_D}\right) = 0 \qquad -\left(\frac{0.3\tau_D + 3}{0.3\tau_D}\right) a^2 + \frac{2K_c}{0.3\tau_D} = 0$$

$$\frac{2K_c\tau_D + 3}{\cancel{0.3\tau_D}} = \frac{2K_c}{\cancel{0.3\tau_D}} \cdot \frac{0.3\tau_D}{(0.3\tau_D + 3)}$$

$$(2K_c\tau_D + 3)(0.3\tau_D + 3) = 0.6K_c\tau_D.$$

$$(2k_c z_D + 3)(0.3 z_D + 3) = 0.6\, k_c z_D$$

$$0.6 k_c z_D^2 + 6 k_c z_D + 0.9 z_D + 9 = 0.6 k_c z_D$$

$$0.6 k_c (z_D^2 - z_D) + 6 k_c z_D + 0.9 z_D + 9 = 0$$

$$0.6 k_c (z_D^2 + 9 z_D) + 0.9 z_D + 9 = 0$$

diff.

$$6 k_c (2 z_D + 9) + 9 = 0$$

$$\boxed{2 z_D + 9 = -\frac{3}{2 k_c}}$$