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QUIZ-01

Answer:

(i) $G_1(s) = \frac{18}{(s+2).(s+5)} = \frac{A}{s+2} + \frac{B}{s+5}$

(a)

$$A = \frac{18}{s+5}\Big|_{s=-2} = \frac{18}{3} = 6$$

$$B = \frac{18}{s+2}\Big|_{s=-5} = \frac{18}{-3} = -6$$

$$G_1(s) = \frac{6}{s+2} - \frac{6}{s+5}$$

$$\mathcal{L}^{-1}\{G_1(s)\} = 6e^{-2t} - 6e^{-5t}$$

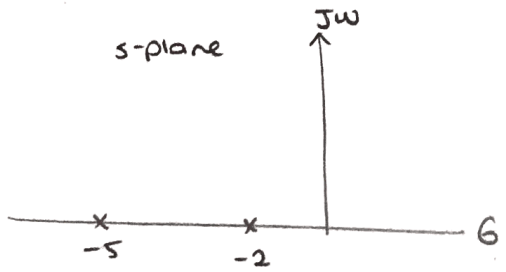
$$g_1(t) = 6e^{-2t} - 6e^{-5t}$$

$$\rightarrow G_1(s) = \frac{18}{s^2+7s+10} = \frac{\omega_n^2}{s^2+2\zeta\omega_n+\omega_n^2} \Longrightarrow \omega_n^2 = 10$$

$$2\zeta\omega_n = 7$$

$\omega_n = 3.16$ (natural frequency)

$\zeta = 1.108$ (dumping ratio)



(b) $G_1(s) = \frac{18}{(s+2)(s+5)} \rightarrow C(s) = \frac{18}{s(s+2)(s+5)} = \frac{A}{s} + \frac{B}{s+2} + \frac{C}{s+5}$

$$A = \frac{18}{(s+2)(s+5)}\Big|_{s=0} = 1.8$$

$$B = \frac{18}{s.(s+5)}\Big|_{s=-2} = -3$$

$$C = \frac{18}{s.(s+2)}\Big|_{s=-5} = 1.2$$

$$C_1(s) = \frac{1.8}{s} + \frac{3}{s+2} + \frac{1.2}{s+5}$$

$$c_1(t) = 1.8 - 3e^{-2t} + 1.2e^{-5t}$$

(OVERDAMPED)

(c)

At steady state,

i.e. $t \to \infty$

$$c(t) = 1 - \frac{e^{-3.500}}{\sqrt{1-\zeta^2}} \cdot \cos(\omega_0 t + \phi_1)$$

$\boxed{c(t) = 1}$ at steady state

$\therefore \zeta > 1$

(d)

$\therefore$ peak value $= 1$

Settling time $t_s = \frac{4}{\zeta \omega_n}$

$$= \frac{4}{3.5}$$

$$= 1.142 \text{ sec}$$

Peak time cannot be calculated. As it does not form any peak, but get to its final value is system is overdamped.