الإجابة النموذجية. الأنظمة الديناميكية والتحكم page ①

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س1 - (P).

$$a-\ f(t) = 3 + t + t^3 + \sin 3t\, e^{-t}$$

$$F(s) = \frac{3}{s} + \frac{1}{s^2} + \frac{6}{s^4} + \frac{3}{(s+1)+(3)^2}$$

$$b)\quad F(s) = \frac{2s+4}{s(s^2+4s+3)} = \frac{2s+4}{s(s+1)(s+3)} = \frac{A}{s} + \frac{B}{s+1} + \frac{C}{s+3}$$

$$2s+4 = A(s^2+4s+3) + Bs(s+3) + Cs(s+1)$$

$$2s+4 = (A+B+C)s^2 + (4A+3B+C)s + 3A$$

$$3A = 4 \Rightarrow \boxed{A = 4/3}$$

$$4A + 3B + C = 2 \quad —①$$

$$A + B + C = 0 \quad —2$$

① - ②

$$3A + 2B = 2 \Rightarrow \cancel{3}\frac{4}{\cancel{3}} + 2B = 2 \Rightarrow \boxed{B = -1}$$

$$A+B+C = 0 \Rightarrow C = -\frac{4}{3} + 1 = -\frac{1}{3} \Rightarrow \boxed{C = -\frac{1}{3}}$$

$$\therefore F(s) = \frac{4/3}{s} - \frac{1}{s+3} - \frac{1/3}{s+1}$$

$$f(t) = 4/3 - e^{-3t} - 1/3\, e^{-t}$$

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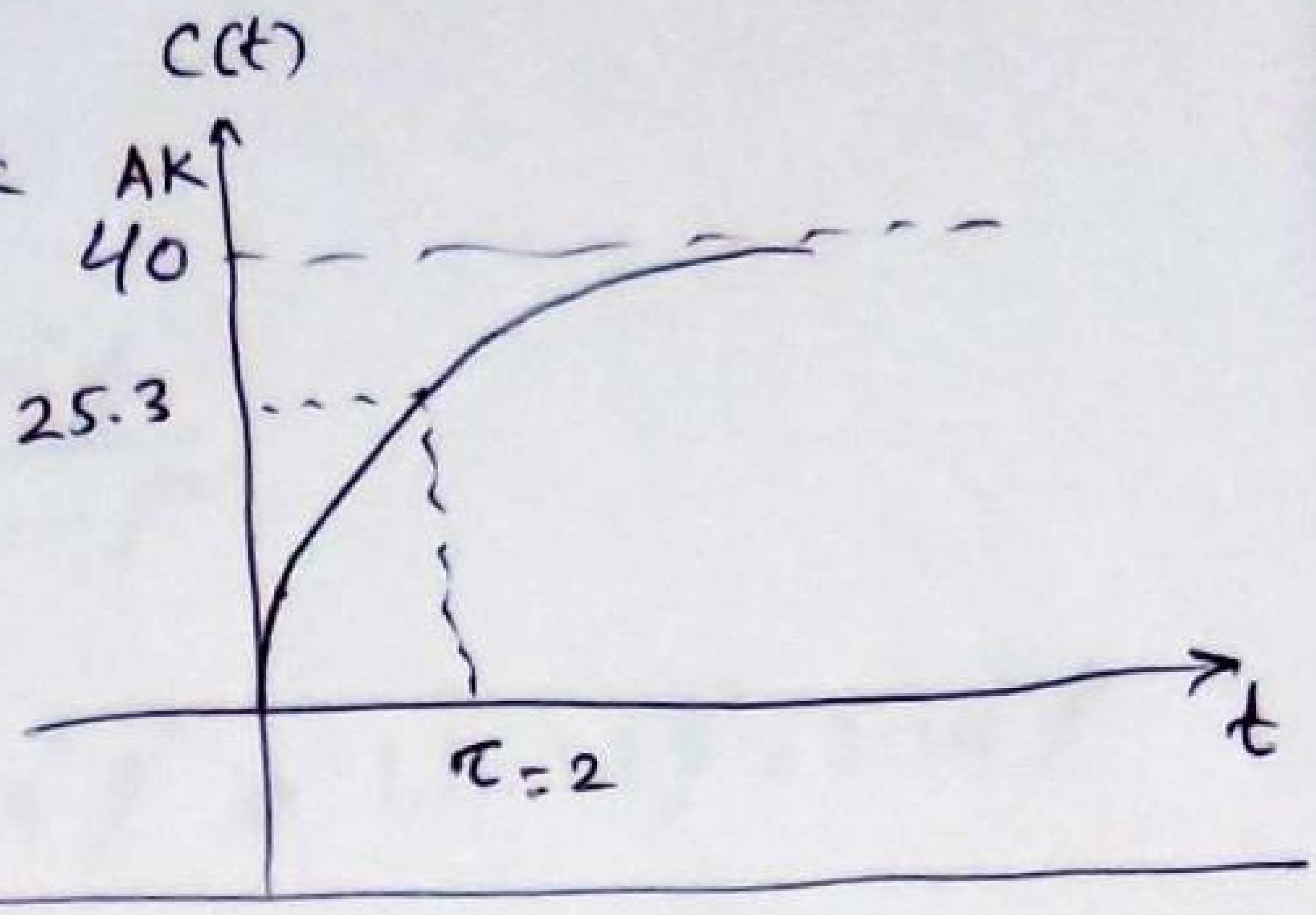
(ب)

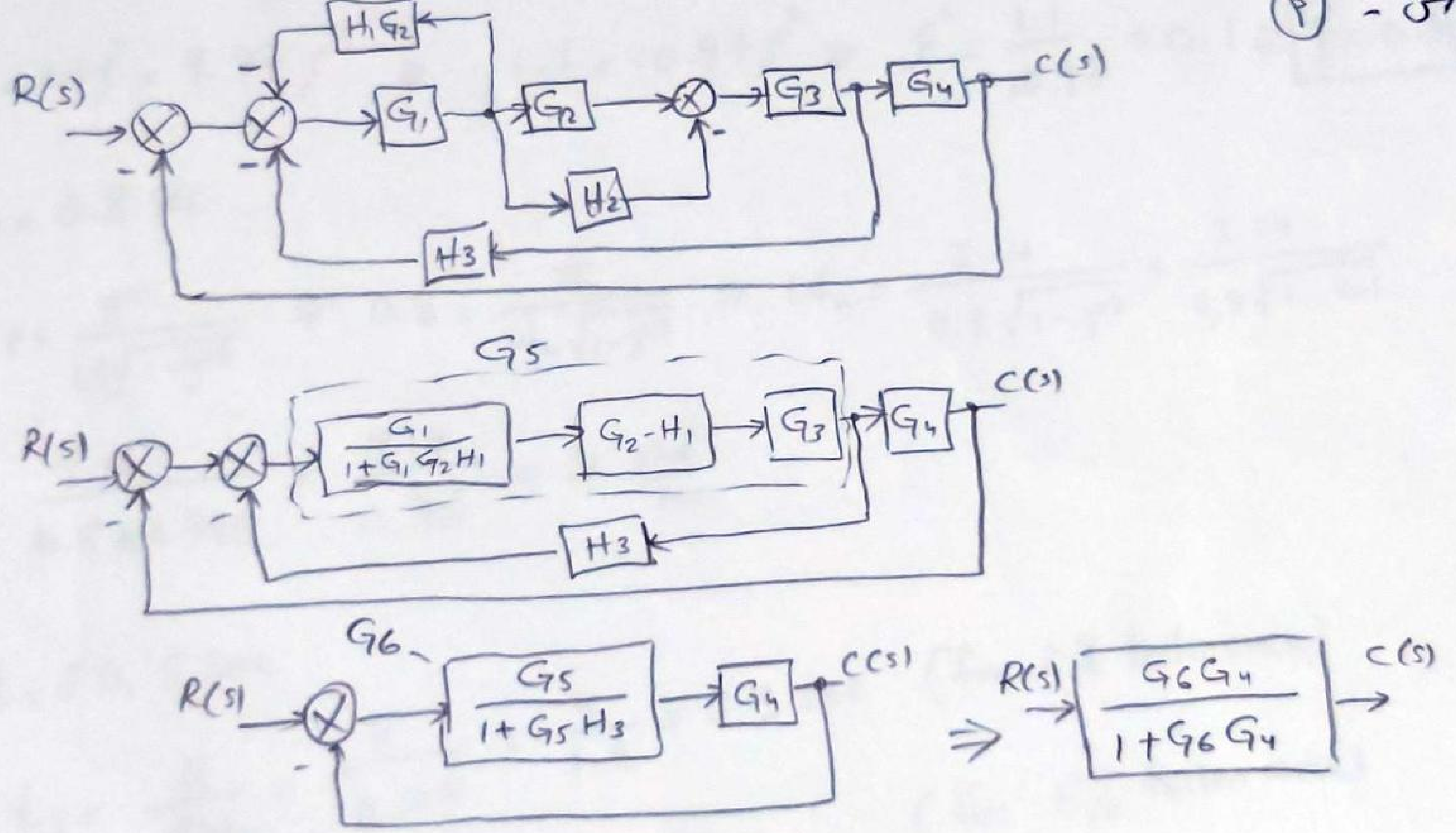
$$\frac{C(s)}{R(s)} = \frac{8}{4S+2} \quad , R(s) = \frac{10}{s}$$

$$\frac{C(s)}{R(s)} = \frac{8}{2(2S+1)} \Rightarrow k = 4 \ , \tau = 2 \text{ sec}$$

Final value $= KA = 4 \times 10 = 40$



(P) - س2



- Paths:

$P_1 = G_1 G_2 G_3 G_4 G_5 G_6 \ , \ P_2 = G_7 G_6 \ , \ P_3 = G_1 G_8$

- Loops:

$L_1 = -G_1 G_2 G_3 G_4 G_5 H_1 \ , \ L_2 = -G_2 G_3 H_2 \ , \ L_3 = -G_5 G_6 H_3 \ , \ L_4 = -G_7 H_1$

- 2 nontouching loops:

$L_2 L_3 \ , \ L_2 L_4$

- 3 nontouching loops = non

- $\Delta_1 = 1 - (0) = 1$

$\Delta_2 = 1 - (0) = 1$

$\Delta_3 = 1 - (L_2) = 1 - L_2$

$$\Delta = 1 - (L_1 + L_2 + L_3 + L_4) + (L_2 L_3 + L_2 L_4)$$

$$\frac{C(s)}{R(s)} = \frac{P_1 \Delta_1 + P_2 \Delta_2 + P_3 \Delta_3}{\Delta}$$

$$- \quad M_p\% = \frac{C(t_p) - C(\infty)}{C(\infty)} \times 100\% = \frac{6{,}75 - 5}{5} * 100\% = 35\%$$

$$0{,}35 = e^{-\frac{\pi \xi}{\sqrt{1-\xi^2}}}$$

$$\ln(0{,}35) = -\frac{\pi \xi}{\sqrt{1-\xi^2}} \Rightarrow (\ln(0{,}35))^2 = \frac{\pi^2 \xi^2}{1-\xi^2}$$

$$(-1.05)^2 = \frac{\pi^2 \xi^2}{1-\xi^2} \Rightarrow 1.1(1-\xi^2) = 3.14^2 \xi^2 \Rightarrow 1.1 - 1.1\xi^2 = 3.14^2 \xi^2$$

$$1.1 - 1.1\xi^2 = 9.87\xi^2 \Rightarrow 1.1 = 10.97\xi^2 \Rightarrow \xi^2 = \frac{1.1}{10.97} = 0.1 \Rightarrow \boxed{\xi = 0.3}$$

$$- \quad t_p = 0.8 \text{ sec}$$

$$t_p = \frac{\pi}{\omega_n \sqrt{1-\xi^2}} \Rightarrow 0.8 = \frac{\pi}{\omega_n \sqrt{1-\xi^2}} \Rightarrow \omega_n = \frac{3.14}{0.8\sqrt{1-\xi^2}} = \frac{3.14}{0{,}8\sqrt{1-0.1}}$$

$$\omega_n = \frac{3.14}{0.8 * 0.948} = \frac{3.14}{0.76} = 4 \ \frac{rad}{sec}$$

$$- \quad t_r \cong 0{,}5 \text{ sec}$$

$$- \quad t_s = \frac{4}{\xi \omega_n} = \frac{4}{0.3 * 4} = \frac{4}{1.2} = 3.3 \text{ sec} \quad \text{(for 2\% tollerance)}$$

$$= \frac{3}{\xi \omega_n} = \frac{3}{1.2} = 2.5 \text{ sec} \quad \text{(for 5\% tollerance)}$$

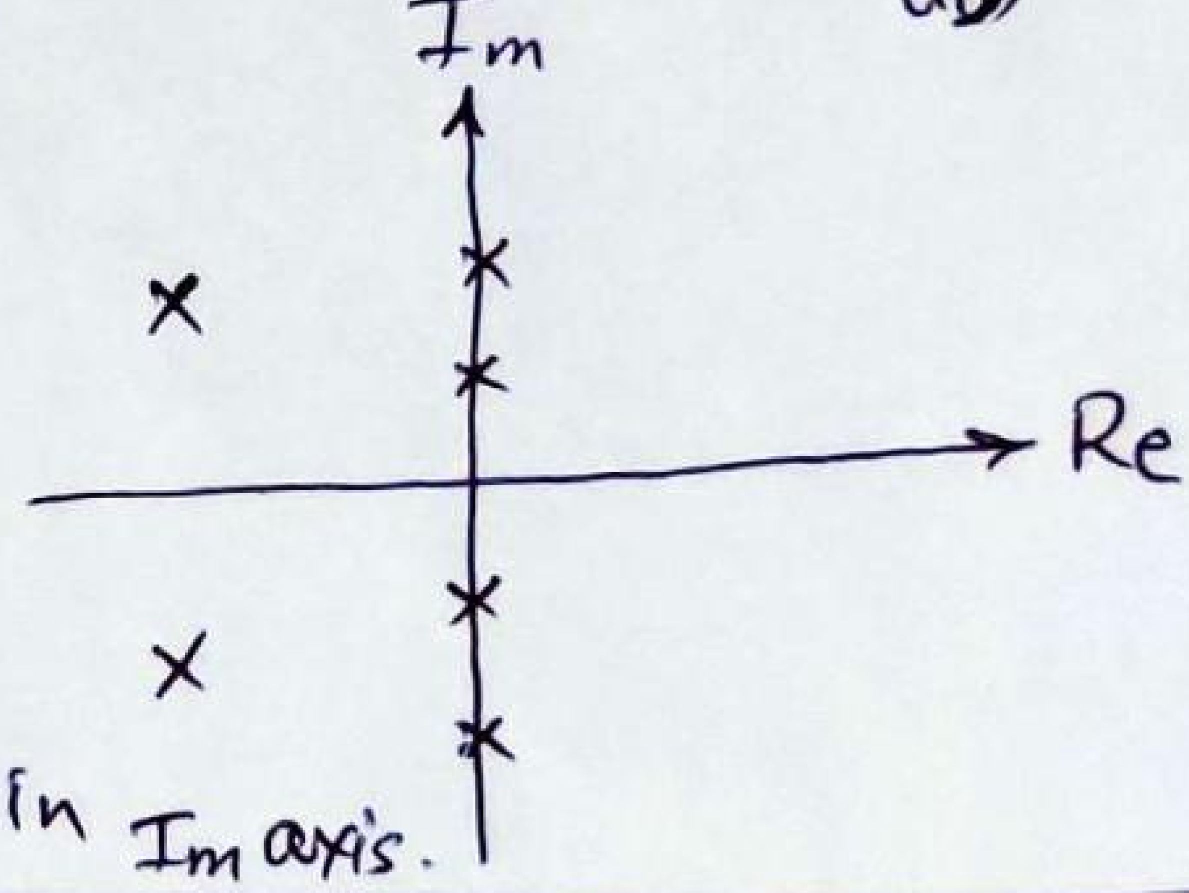
$$T.F = \frac{16}{S^2 + 2 * 0.3 * 4 S + 16} = \frac{16}{S^2 + 2.4S + 16}$$

$Q(s) = s^6 + s^5 + 6s^4 + 5s^3 + 10s^2 + 5s^1 + 5 = 0$ [illegible]

s^6	$1 > 0$	6	10	5
s^5	$1 > 0$	5	5	0
s^4	$\frac{6-5}{1} = 1 > 0$	$\frac{10-5}{1} = 5$	5	
s^3	$\cancel{0}\ 4 > 0$	$\cancel{0}\ 10$	0	0
s^2	$\frac{20-10}{4} = 2.5 > 0$	5		
s	$2 > 0$	0		
s^0	$5 > 0$	0		

$D(s) = s^4 + 5s^2 + 5 = 0$

$\frac{d}{ds} = 4s^3 + 10s + 0$



System is stable

Due to 4th order D(s), system has 4 pools in Im axis.