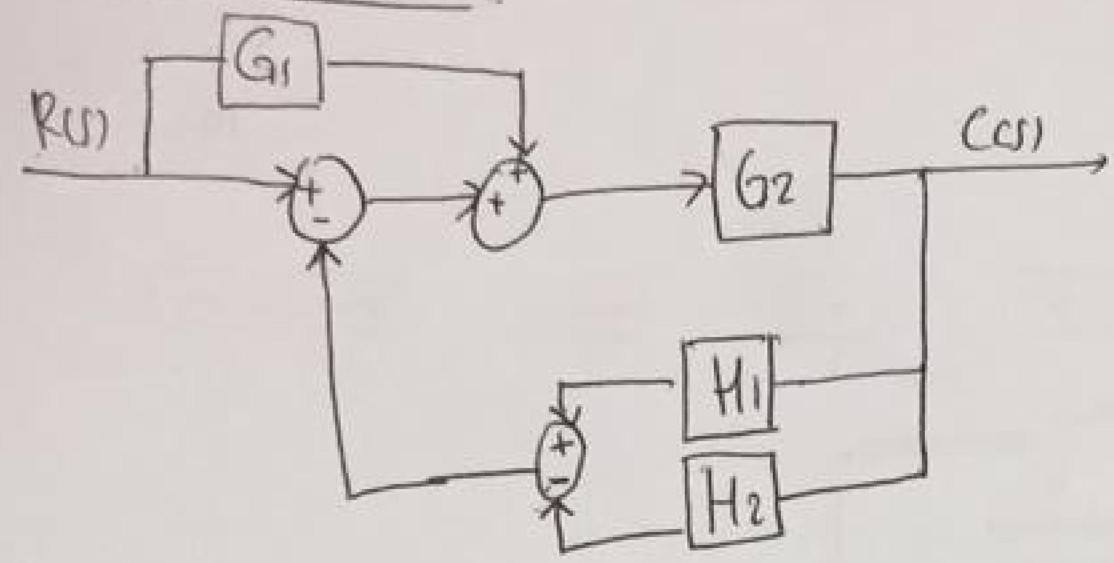
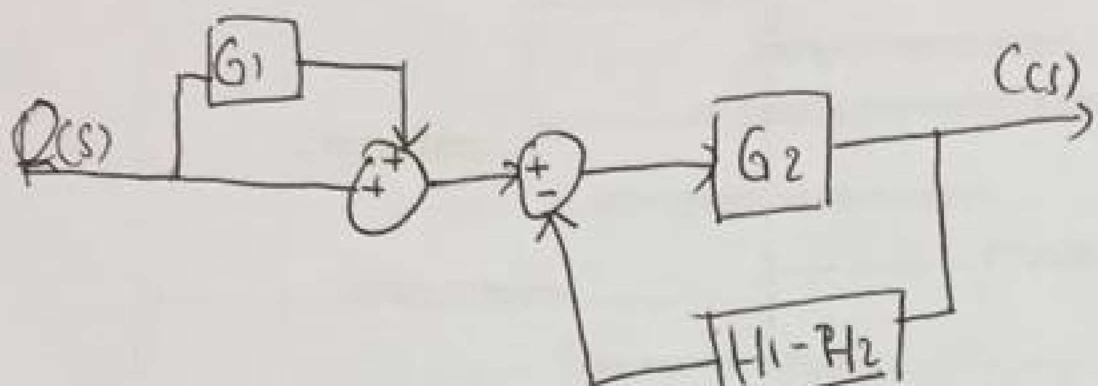
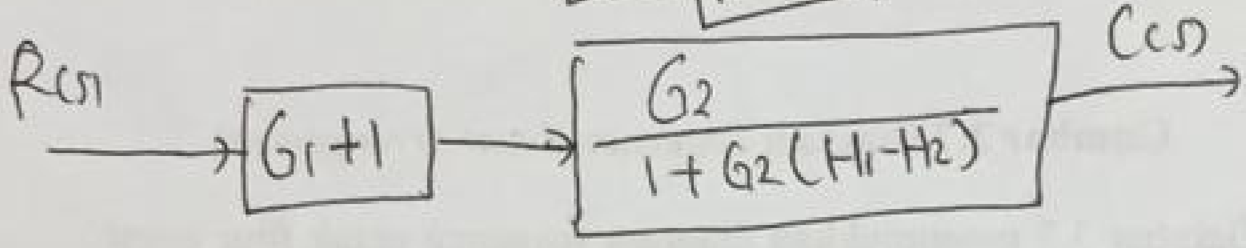
Jawaban Quiz

1







$$\boxed{\frac{C(s)}{R(s)} = \frac{G_2(G_1+1)}{1+G_2(H_1-H_2)}}$$

2 Open-loop TF : $G(s) = \frac{2s+1}{s^2}$

$$\frac{C(s)}{R(s)} = \frac{\frac{2s+1}{s^2}}{1+\frac{2s+1}{s^2}} = \frac{\frac{2s+1}{\cancel{s^2}}}{\frac{s^2+2s+1}{\cancel{s^2}}} = \frac{2s+1}{s^2+2s+1}$$

* Unit Step (1/s).

$$C(s) = \frac{2s+1}{s^2+2s+1} \cdot \frac{1}{s}.$$

$$\left[\frac{2s+1}{s(s+1)^2} = \frac{A}{s+1} + \frac{B}{(s+1)^2} + \frac{C}{s}\right] \times s(s+1)^2$$

$$2s+1 = As(s+1) + Bs + C(s+1)^2$$

$$2s+1 = As^2 + As + Bs + Cs^2 + 2Cs + C$$

$C = 1$

$A + C = 0$

$A = -1$

$A + B + 2C = 2.$

$A + B = 0$

$B = 1$

$$C(s) = \frac{1}{s} - \frac{1}{s+1} + \frac{1}{(s+1)^2}$$

$$\boxed{c(t) = 1 - e^{-t} + t\,e^{-t}}$$

* Unit Impulse (1)

$$C(s) = \frac{2s+1}{s^2+2s+1}$$

$$\left[\frac{2s+1}{s^2+2s+1} = \frac{A}{s+1} + \frac{B}{(s+1)^2}\right] \times (s+1)^2$$

$$2s+1 = A(s+1) + B$$

$$2s+1 = As + A + B$$

$$A = 2$$

$$A + B = 1$$

$$2 + B = 1$$

$$B = -1$$

$$C(s) = \frac{2}{s+1} - \frac{1}{(s+1)^2}$$

$$\boxed{c(t) = 2e^{-t} - te^{-t}}$$

3) $TF = C(SI-A)^{-1}B + D$

$$TF = G(s) = \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} s+5 & 1 \\ -3 & s+1 \end{bmatrix}^{-1} \begin{bmatrix} 2 \\ 5 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 2 \end{bmatrix} \frac{1}{(s+5)(s+1)+3} \begin{bmatrix} s+1 & -1 \\ 3 & s+5 \end{bmatrix} \begin{bmatrix} 2 \\ 5 \end{bmatrix}$$

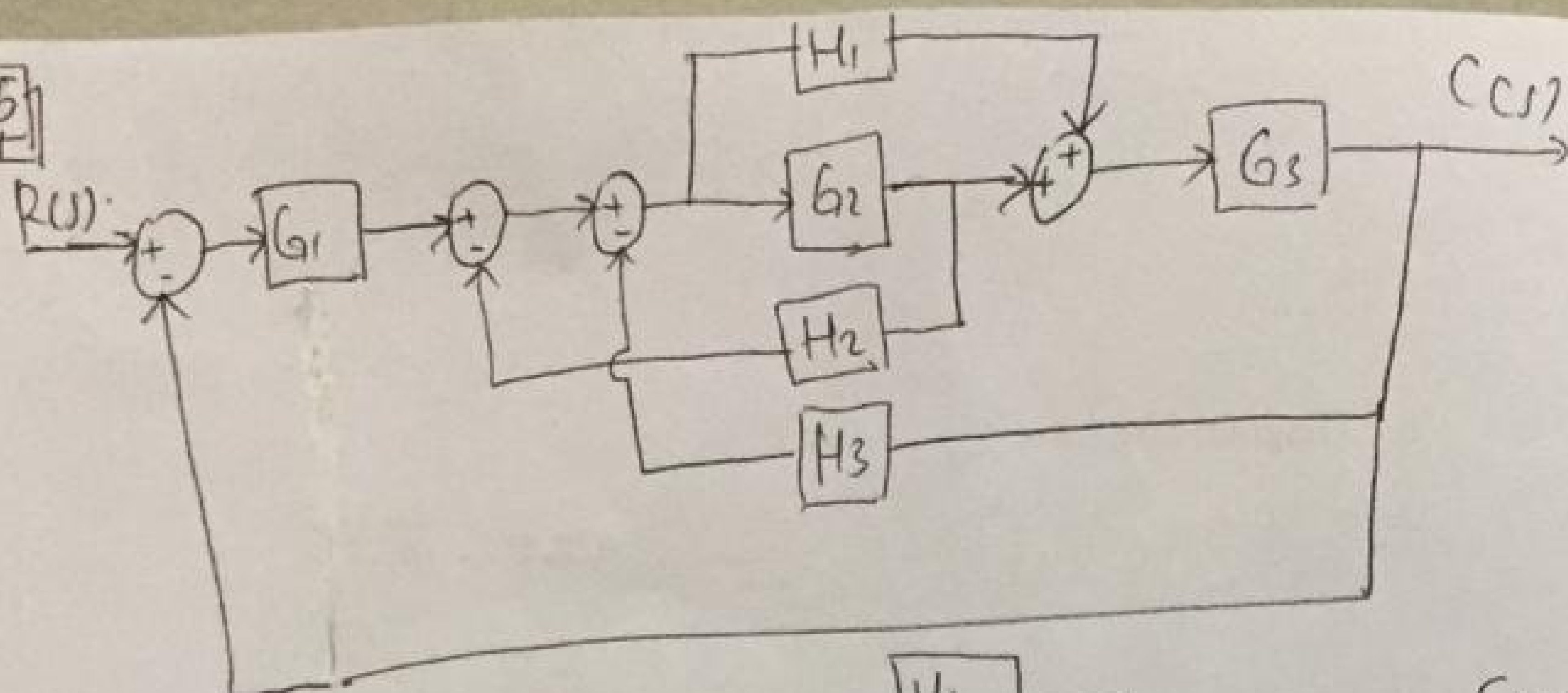
$$= \frac{1}{s^2+6s+8} \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} 2s-3 \\ 5s+31 \end{bmatrix} = \boxed{\frac{12s+59}{s^2+6s+8}}$$

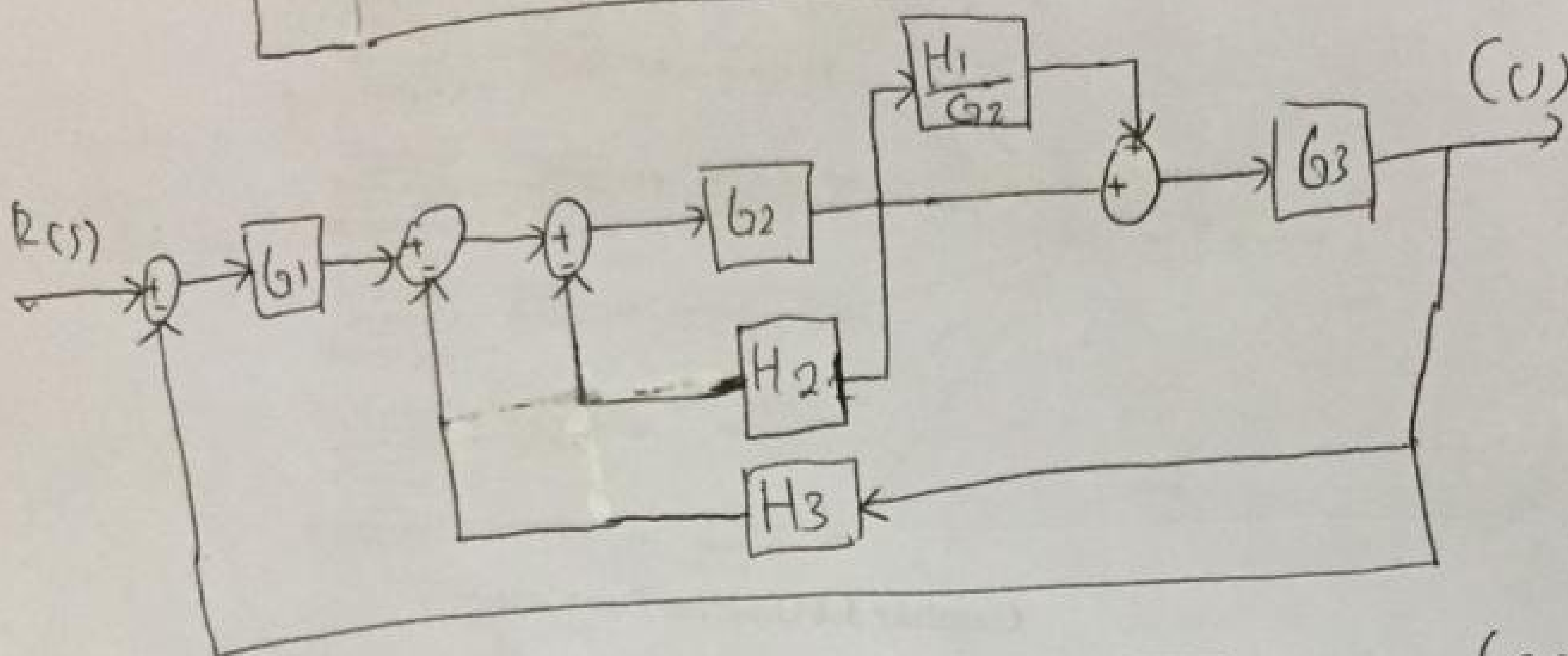
4) $TF = G(s) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} s+4 & 1 \\ -3 & s+1 \end{bmatrix}^{-1} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

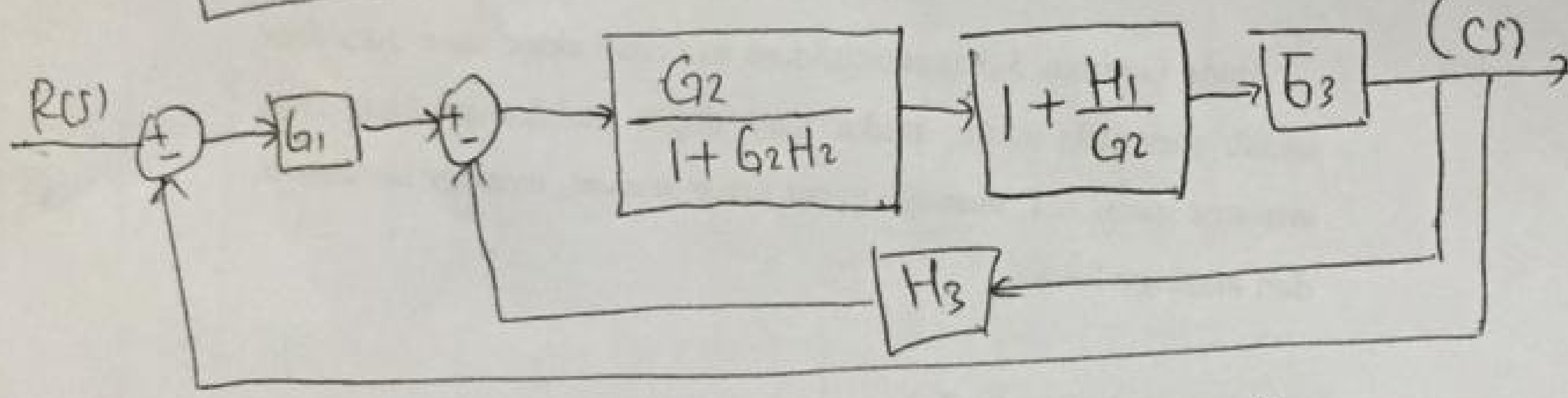
$$= \begin{bmatrix} 1 & 0 \end{bmatrix} \frac{1}{(s+4)(s+1)+3} \begin{bmatrix} s+1 & -1 \\ 3 & s+4 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

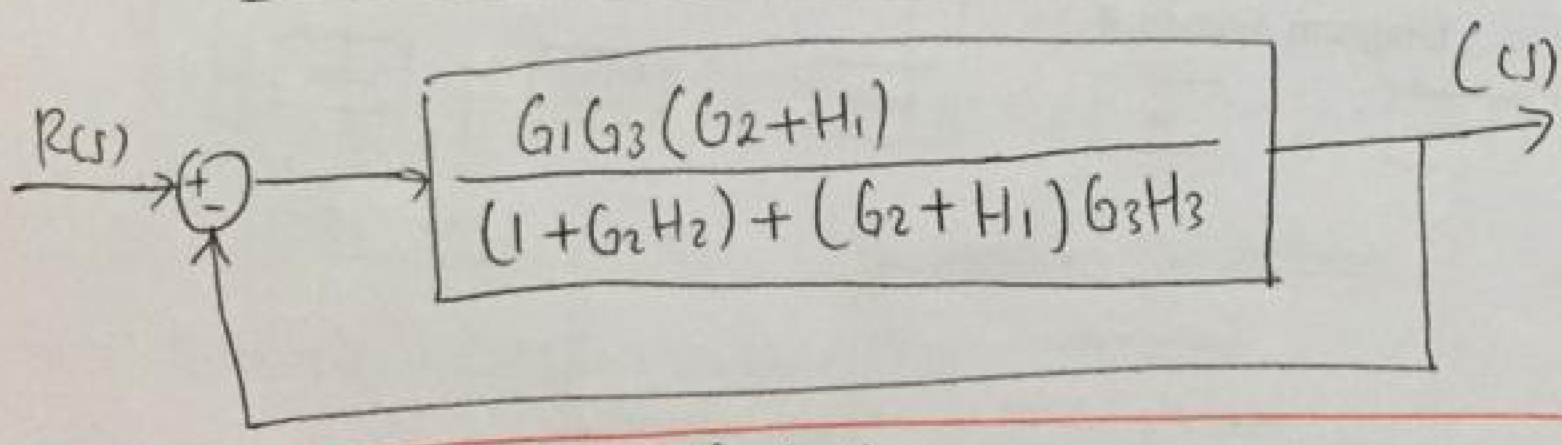
$$\boxed{G(s) = \frac{s}{s^2+5s+7}}$$

5









$$\frac{C(s)}{R(s)} = \frac{G_1G_2G_3 + G_1G_3H_1}{1 + G_2H_2 + G_2G_3H_3 + G_3H_1H_3 + G_1G_2G_3 + G_1G_3H_1}$$

6

(i) $m_1 \ddot{y}_1 = -k_1 y_1 - b_1 \dot{y}_1 + b_1 \dot{y}_2 + u_1$

(ii) $m_2 \ddot{y}_2 = -b_1 \dot{y}_2 + b_1 \dot{y}_1 - k_2 y_2 + u_2$

mh.

(i) $m_1 \ddot{y}_1 + b_1 \dot{y}_1 + k_1 y_1 - b_1 y_2 = u_1$

(ii) $m_2 \ddot{y}_2 + b_1 \dot{y}_2 + k_2 y_2 - b_1 \dot{y}_1 = u_2$

misal

$x_1 = y_1$

$x_2 = \dot{y}_1$

$x_3 = y_2$

$x_4 = \dot{y}_2$

mk

(i) $m_1 \dot{x}_2 + b_1 x_2 + k_1 x_1 - b_1 x_4 = u_1 \rightarrow \dot{x}_2 = -\frac{1}{m_1}\left[b_1(x_2 - x_4) + k_1 x_1\right] + \frac{1}{m_1} u_1$

(ii) $m_2 x_4 + b_1 x_4 + k_2 x_3 - b_1 x_2 = u_2 \rightarrow \dot{x}_4 = \frac{-1}{m_2}\left[b_1(x_4 - x_2) + k_2 x_3\right] + \frac{1}{m_2} u_2$

dibentuk state space:

$$\dot{x}_1 = x_2$$
$$\dot{x}_2 = -\frac{1}{m_1}\left[b_1(x_2 - x_4) + k_1 x_1\right] + \frac{1}{m_1} u_1$$

$$x_3 = x_4$$
$$\dot{x}_4 = -\frac{1}{m_2}\left[b_1(x_4 - x_2) + k_2 x_3\right] + \frac{1}{m_2} u_2$$

$$y_1 = x_1 \ ; \ y_2 = x_3$$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -\frac{k_1}{m_1} & -\frac{b_1}{m_1} & 0 & \frac{b_1}{m_1} \\ 0 & 0 & 0 & 1 \\ 0 & \frac{b_1}{m_2} & -\frac{k_2}{m_2} & -\frac{b_1}{m_2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ \frac{1}{m_1} & 0 \\ 0 & 0 \\ 0 & \frac{1}{m_2} \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$$

[7] loop terbuka : $G(s) = \frac{1}{s(s+1)}$

$$\frac{C(s)}{R(s)} = \frac{\frac{1}{s(s+1)}}{1 + \frac{1}{s(s+1)}} = \frac{\frac{1}{\cancel{s(s+1)}}}{\frac{s^2+s+1}{\cancel{s(s+1)}}} = \frac{1}{s^2+s+1}$$

bentuk umum second order: $\frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$

$\omega_n^2 = 1 \rightarrow \omega_n = 1.$

$2\zeta\omega_n = 1$

$2\zeta . 1 = 1.$

$\zeta = \frac{1}{2}$

$\omega_d = 1\sqrt{1 - \frac{1}{4}} = \frac{1}{2}\sqrt{3} \ ; \ \sigma = \frac{1}{2}$

$\beta = \tan^{-1}\left(\frac{1}{2}\sqrt{3} / \frac{1}{2}\right) = 60^\circ = 1{,}047 \text{ rad}$

$t_r = \frac{3{,}14 - 1{,}047}{\frac{1}{2}\sqrt{3}} = 2{,}42$ second

$tp = \frac{3,14}{1/2\sqrt{3}} = 3,63$ second

$Mp = e^{-(1/2 / 1/2\sqrt{3})3,14} = 0,163 \times 100\% = 16,3\%$.

$ts \rightarrow 2\%$ criterion, $ts = \frac{4}{1/2} = 8$ second

5% criterion, $ts = \frac{3}{1/2} = 6$ second.

8) $Mp = 5\%$

$ts = 2$ det

ts (2% criterion) $= \frac{4}{\sigma} = 2$.

$\sigma = 2$

$0,05 = e^{-(2/\omega d)3,14}$

$0,05 = e^{-A}$ cari pakai ln

$A = 3 = \frac{2 \cdot 3,14}{\omega d}$

$\omega d = 2,1$

$\zeta \omega n = 2 \rightarrow \omega n = 2/\zeta$

$\omega n \sqrt{1-\zeta^2} = 2,1$

$\frac{2}{\zeta}\sqrt{1-\zeta^2} = 2,1$

$\sqrt{1-\zeta^2} = 1,05\zeta$

$1-\zeta^2 = 1,1025\zeta^2$

$2,1025\zeta^2 = 1$

$\zeta = 0,69$ det

$0,69\,\omega n = 2$

$\omega n = 2,89$ det