Prelab 3

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Alex Bartella
ID 30888

1) $G(s) = \Omega(s) / V(s)$

$$= \frac{A}{\tau s + 1}$$

$$v(t) = V_x u(t)$$

$$V(s) = \mathcal{L}\{V_x u(t)\}$$

$$= V_x / s$$

$$\Omega(s) = \frac{A}{\tau s + 1} \times \frac{V_x}{s}$$

$$= \frac{A V_x}{\tau s^2 + s}$$

$$f(\infty) = \lim_{s \to 0} s F(s)$$

$$\omega(\infty) = \lim_{s \to 0} s \Omega(s)$$

$$= \lim_{s \to 0} \frac{A V_x}{\tau s + 1}$$

$$= A \cdot V_x$$

$= A \cdot V_x$

$(\omega)_{steady} = A \cdot V_x$

b)

$$\Omega(s) = \left(\frac{A}{\tau s + 1}\right)\left(\frac{V_x}{s} + \omega_0\right)$$

$$= \left(\frac{AV_x}{\tau s^2 + s} + \frac{A\omega_0}{\tau s + 1}\right)$$

$$= \frac{AV_x}{s(s\tau + 1)} + \frac{A\omega_0}{\tau s + 1}$$

$$= \mathcal{L}^{-1}\left\{\frac{AV_x}{s(s\tau + 1)}\right\} + \mathcal{L}^{-1}\left\{\frac{A\omega_0}{\tau s + 1}\right\}$$

$$= AV_x - AV_x e^{-t/\tau} + \frac{A\omega_0}{\tau} e^{-t/\tau}$$

c) $\lim_{t \to \infty} \omega(t) = \lim_{t \to \infty} \left(AV_x - AV_x e^{-t/\tau} + \frac{A\omega_0}{\tau} e^{-t/\tau}\right)$

$$= A \cdot V_x$$

∴ answers from a & b match.

d)

$$\omega_0 = A V_{th}$$
$$\omega_{ss} = A V_{max}$$

$$A = \frac{\Delta\omega}{\Delta V} = \frac{\omega_{ss} - \omega_0}{V_{max} - V_{th}}$$

$$= \frac{A(V_{max} - V_{th})}{V_{max} - V_{th}}$$

$$= A$$

2)

$$A = \frac{\omega_{ss} - \omega_0}{V_{max} - V_{th}}$$

$$= \frac{25 - 5}{5 - 1}$$

$$\boxed{A = 5\,V}$$

3)

$$t = t_1 - t_0$$
$$= 0.8 - 0.75$$
$$= 0.05\,s$$

4)

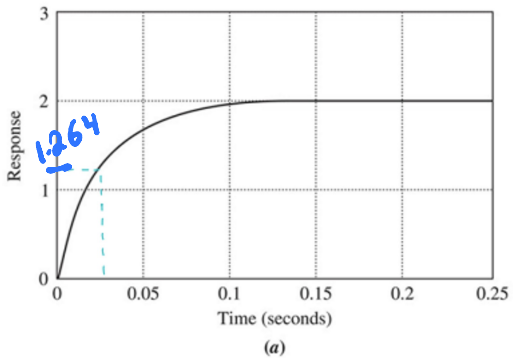
$$G_{...}(s) = \frac{A}{}$$

4) $G_w(s) = \frac{A}{\tau s + 1}$

$= \frac{5}{0.05s + 1}$

$= \frac{100}{s + 20}$

5)



$w_{ss} = 2$

$w(t_1) = 0.632(2)$

$= 1.264$

$t_1 \approx 0.025$

$\tau = t_1 - t_0 = 0.025 - 0 = 0.025$

$a = \frac{1}{\tau} = 40$

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

$s^2 + as$

$$C(\infty) = \omega_{ss}^2 = k/a$$

$$k = 2a \doteq 80$$

$$\boxed{G(s) = \frac{80}{s + 40}}$$