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USTA 8 CMK 12 COMP 22

Q1

$$D(s) - Y(s)(K_p + K_d s) = Y(s) \cdot s(ms + b)$$

$$1 = G(s)(ms^2 + (b + K_d)s + K_p)$$

$$G(s) = \frac{1}{ms^2 + (b + K_d)s + K_p}$$

$$d(t) = A_d \operatorname{sen}(\omega t + \phi_d)$$

$$y(t) = A_y \operatorname{sen}(\omega t + \phi_y)$$

$$G(j\omega) = \frac{1}{(K_p - m\omega^2) + (b + K_d)\omega j}$$

$$A_y = \frac{A_d}{\sqrt{(K_p - m\omega^2)^2 + (b + K_d)^2 \omega^2}}$$

$$\phi_y = \phi_d - \operatorname{atan}\left(\frac{\omega(b + K_d)}{K_p - m\omega^2}\right)$$

Q2

$$G(s) = \frac{2(s+10)}{(s-(-1+j))(s-(-1-j))}$$

$$G(s) = 10 \cdot \frac{s-10}{10} \cdot \frac{1-j}{s+1-j} \cdot \frac{1+j}{s+1-j}$$

$$|G(jw)|_{dB} = 20 + 20\log\left|\frac{1-j}{jw+1-j}\right| + 20\log\left|\frac{1+j}{jw+1-j}\right| - 20\log\left|\frac{10}{jw+10}\right|$$

$w_n = \sqrt{2}$

$$\angle(G(jw)) = \text{atan}(w/10) - \text{atan}(w-1) - \text{atan}(w+1)$$

Q4

$$(R(s) - Y(s))\frac{k}{ms+b} = Y(s)$$

$$k \cdot R(s) = Y(s)(ms+b+k)$$

$$Y(s) = \frac{k}{s(ms+b+k)}$$

$$E(s) = R(s) - Y(s) = \frac{ms+b}{s(ms+b+k)}$$

$$e_{ss} = \frac{50}{50+K}$$

$$\frac{50}{5+K} \le 0.1$$

$$5+K \ge 450$$

$$50 \le 5+0.1K$$

$$K \ge 450$$

$$-(Y(s)+N(s))\frac{K}{ms+b} = Y(s)$$

$$-(G_N(s)+1)K = G_N(s)(ms+b)$$

$$-K = G_N(s)\cdot(ms+b+K)$$

$$G_N(jw) = -\frac{K}{mjw+b+K}$$

$$|G_N(10j)| = \frac{k}{\sqrt{b+k)^2+100m^2}}$$

$$k^2 \le \frac{50+k)^2+100m^2}{100}$$

$$k^2 \le \frac{25+k-k^2+10^6}{100}$$

$$\text{Scalar}\left(\frac{k}{\sqrt{b+k)^2+100m^2}}\right) \le -20$$

$$\frac{K}{\sqrt{b+k)^2+100m^2}} \le 0.1$$

$$99k^2 - 100K - 10000 \le 0$$

$$-24.5 \le k \le 1025_b$$

$$450 \le K \le 1025_{10}$$

25) $[(R(s) - H(s))\,2K_p - sH(s)]\,K_{12}\cdot 2 = H(s)\cdot s^2\cdot 2$

$((1 - G(s))\,2K_p - sG(s))\,K_{12}\cdot 2 = G(s)\,s^2\cdot 2$

$(1 - G(s))\,2^2 K_p K_{12} = G(s)(s^2 2 + s2K_{12})$

$2K_p K_{12} = G(s)(s^2 + sK_{12} + K_{12}K_p 2)$

$G(s) = \dfrac{K_{12}K_p 2}{s^2 + sK_{12} + K_{12}K_p 2} = \dfrac{K_{12}K_p}{s^2 + sK_{12} + K}$

$$\begin{cases} 6 = \omega_n\sqrt{1 - 2\xi^2} + \sqrt{4\xi^4 - 4\xi^2 + 2} \\ 20\log_{10}\left(\dfrac{1}{2\xi\sqrt{1-\xi^2}}\right) = 0{,}3546 \end{cases}$$

~~$\xi = 0{,}8$~~ $\quad \xi = 0{,}6 \quad \omega_n = 5{,}225$

$K_{12} = 6{,}27$

$K_p = 4{,}35$