RODRIGO ALVES DE ALMEIDA

PROVA 4 CMC-12 COMP-22

Q1) • $|G(jw_{cp})| = \frac{1}{K} \Rightarrow \frac{10k}{w_{cp}\sqrt{25+w_{cp}^2}\sqrt{100+w_{cp}^2}} = 1$

$K = \frac{w_{cp}\sqrt{25+w_{cp}^2}\sqrt{100+w_{cp}^2}}{10}$ * ~> estritamente crescente para $w_{cp} > 0$

$w_{cp} = 2 \Rightarrow K = 10{,}9836$

$\boxed{K \geq 10{,}9836}$

• $\angle KG(jw) = -\operatorname{atan}\left(\frac{50-w^2}{-15w}\right)$

$\angle KG(jw_{cG}) = -180^\circ \Rightarrow w_{cG} = \sqrt{50}$ rad/s

$|KG(jw_{cp})| = \frac{K}{75} \Rightarrow |KG(jw_{cp})|_{dB} = 20\log_{10}\frac{K}{75} \geq 11$

$\frac{K}{75} \geq 3{,}5481$

$\boxed{K \geq 266{,}11}$

• $\angle KG(jw_{cp}) + 180^\circ \geq 40^\circ$

$-\operatorname{atan}\left(\frac{50-w_{cp}^2}{-15w_{cp}}\right) \geq -140^\circ$

$w_{cp}^2 - 50 \leq 15w_{cp}\tan(140^\circ) \overset{\text{roots}}{\rightsquigarrow} -16 \leq w_{cp} \leq 3{,}173$

como $w_{cp} > 0$, de * tira-se que

$\boxed{K \leq 19{,}71}$

02 a) $C(s) = \frac{Ts+1}{\alpha Ts+1}$, $T>0$, $0<\alpha<1$

malha aberta: $G'(s) = \frac{K(Ts+1)}{(s^2+2s)(\alpha Ts+1)}$ $\Rightarrow$ $G_f(s) = \frac{K(Ts+1)}{\alpha Ts^3+(1+2\alpha T)s^2+(2+KT)s+K}$

$E(s) = \frac{1}{s}\left(\frac{\alpha Ts^3+(1+2\alpha T)s^2+2s}{\alpha Ts^3+(1+2\alpha T)s^2+(2+KT)s+K}\right)$ $\quad e_\infty = \lim_{s\to 0} sE(s) = 0$

degrau unitário

ignorando o compensador e considerando $PM = 65^\circ$ $\Rightarrow$ $\angle G(j\omega_{cp}) = -115^\circ$ $\Rightarrow$ $|G(j\omega_{cp})| = 1$

$55^\circ + 10^\circ$

segurança

$115^\circ = atan\left(\frac{2}{-\omega}\right)$

$\omega_{cp} = 0,9326$

$K = \omega_{cp}\sqrt{\omega_{cp}^2+4}$

$K = 2,058$

assim, projetando o lead para fornecer um $\phi_{max} = 55^\circ$ em $\omega_{cp} = 0,9326$, temos

$\alpha = 0,09941$

$T = 3,4008$

testes

$|G_f(j\omega_b)| = \frac{\sqrt{2}}{2}$

$0,11\,\omega_b^6 - 3,28\,\omega_b^4 - 23,89\,\omega_b^2 - 4,23 = 0$

$\omega_b = 5,89$

$|G'(j\omega_{cp})| = 1$

$\omega_{cp} = 3,8$

$\angle G'(j\omega_{cp}) = -119^\circ$

$PM = 61^\circ$

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