

B-6.3

$$G(s) = \frac{K}{s(s+0.5)(s^2+0.6s+10)}$$

$$H(s) = 1$$

$$T_{CL} = \frac{K/[s(s+0.5)(s^2+0.6s+10)]}{1 + K/[s(s+0.5)(s^2+0.6s+10)]} = \frac{K}{s(s+0.5)(s^2+0.6s+10) + K}$$

$$T_{CL} = \frac{K}{(s^2+0.5s)(s^2+0.6s+10)+K} = \frac{K}{s^4+1.1s^3+10.3s^2+5s+K}$$

Open Loop Poles and zeroes

$$P_0 = 0 \quad P_{2,3} = -0.3 \pm j3.148$$

$$P_1 = -0.5 \quad \text{No zeroes}$$

Asymptotes

X-Axis crossings

$$\sigma_2 = \frac{\sum \text{poles} - \sum \text{zeros}}{\# \text{poles} - \# \text{zeros}}$$

$$\sigma_2 = \frac{0 - 0.5 - 0.3 - 0.3}{4} = -0.11$$

Angles

$$\theta_{2k} = \frac{(2k+1)\pi}{4}$$

$$\theta_{20} = \pi/4 \quad \theta_{21} = 5\pi/4$$

$$\theta_{22} = 3\pi/4 \quad \theta_{23} = 7\pi/4$$

x & y crossings

x-crossing

$$1 + \frac{K}{s(s+0.5)(s^2+0.6s+10)} = 0$$

$$K = -(s^4 + 1.1s^3 + 10.3s^2 + 5s)$$

$$\frac{\partial K}{\partial \sigma} = -14\sigma^3 + 3.3\sigma^2 + 20.6\sigma + 5 = 0$$

$$\frac{\partial \sigma}{\partial \omega} = 0$$

$$\sigma_1 = -0.25 \quad \sigma_{2,3} = -0.2876 \pm j2.2189$$

↳ N20 converges

$$K > 0$$

$$28.772 - 1.1K > 0$$

$$1.1 < 28.772$$

$$K < 26.1570$$

$$s = 0 \pm j2.132$$

Substituting into

Characteristic

Equation

y-crossing

$$s^4 \quad 1 \quad 10.3 \quad K$$

$$s^3 \quad 1.1 \quad 5$$

$$s^2 \quad 5.754 \quad K$$

$$s \quad 28.772 - 1.1K \quad 0$$

$$s^0 \quad 5.754$$

$$s^0 \quad K$$

Departure and Arrival angles

No finite zeroes \Rightarrow No Arrival angles

Departure angles

$$\theta_3 = -\angle(p_x - p_1) - \angle(p_x - p_2) - \angle(p_x - p_c) - (2k+1)\pi$$

$$\theta_3 = -\angle(-0,3 + j3,148 - 0) - \angle(0,3 + j3,148 + 0,5) - \angle(2,53,148) - (2k+1)\pi$$

$$\theta_3 = -\angle(-0,3 + j3,148) - \angle(0,8 + j3,148) - \pi/2 - (2k+1)\pi$$

$$\theta_3 = -271,8085^\circ = 268,1914^\circ$$

