

Q1) $G(z) = \frac{z-3}{z(z+0.5)}$

ECE 480 Homework 3 2015-2016 spring
we want to place the closed loop poles
to locations ~~0.1, 0.2, 0.1~~
 $z_1 = -0.2 \quad z_2 = 0.2 \quad z_3 = 0.1 //$

$$Q(z) = (z+0.2)(z-0.2)(z-0.1) = (z^2 - 0.04)(z-0.1) \\ = z^3 - 0.1z^2 - 0.04z + 0.004 //$$

$$1 + G(z)C(z) = 1 + \frac{z-3}{z(z+0.5)} \frac{(p_0 + p_1 z)}{(l_0 + l_1 z)} = \frac{z(z+0.5)(l_0 + l_1 z) + (z-3)(p_0 + p_1 z)}{z(z+0.5)(l_0 + l_1 z)}$$

$$\begin{aligned} & [z^2 + 0.5z][l_0 + l_1 z] + [z-3][p_0 + p_1 z] \\ &= l_1 z^3 + 0.5l_1 z^2 + 0.5l_0 z + l_0 z^2 + [p_1 z^2 - 3p_1 z + p_0 z - 3p_0] \\ &= l_1 z^3 + [0.5l_1 + l_0]z^2 + 0.5l_0 z + p_1 z^2 - 3p_1 z + p_0 z - 3p_0 \\ &= l_1 z^3 + [0.5l_1 + l_0 + p_1]z^2 + [0.5l_0 + p_0 - 3p_1]z - 3p_0 \\ &= z^3 - 0.1z^2 - 0.04z + 0.004 \end{aligned}$$

$l_1 = 1$
 $p_0 = \frac{-0.004}{3}$
 $[0.5l_1 + l_0 + p_1] = -0.1$
 $0.5 + l_0 + p_1 = -0.1$
 $l_0 + p_1 = -0.6$
 $[0.5l_0 + p_0 - 3p_1] = -0.04$
 $0.5l_0 + \left[\frac{-0.004}{3}\right] - 3p_1 = -0.04$
 $-3p_0 = 0.004$

$l_0 + p_1 = -0.6$
 $0.5l_0 - 3p_1 = \frac{0.004}{3} - 0.04$
 $0.5l_0 - 3p_1 = \frac{0.004 - 0.12}{3}$
 $0.5l_0 - 3p_1 = \frac{-0.116}{3}$

$l_0 + p_1 = -0.6$
 $1.5l_0 - 9p_1 = -0.116$
 $p_1 = \frac{-1.568}{21}$

$3l_0 + 3p_1 = -1.8$
 $+ \frac{-3l_0 + 18p_1 = 0.232}{21p_1 = -1.568}$
 $l_0 = p_1 - 0.6$
 $l_0 = \frac{1.568}{21} - 0.6 //$

$$l_1 = 1$$

$$p_0 = \frac{-0.004}{3}$$

$$p_1 = \frac{-1.568}{21}$$

$$l_0 = \frac{1.568 - 12.6}{21} = \frac{-10.032}{21} //$$

$$C(s) = \frac{p_0 + p_1 z}{l_0 + l_1 z} = \frac{-\frac{0.004}{3} - \frac{1.568}{21} z}{\frac{-10.032}{21} + z} //$$