

**Name:**

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The objective of this exercise is to plot the root locus corresponding to a unity feedback system with a characteristic polynomial given as follows:

$$1 + KG(s)H(s) = 1 + K \frac{(s + 2)}{s^2 + 2s + 2}.$$

Answer the following questions. Show your work.

1. Determine the poles and zeros of the open loop transfer function  $(G(s)H(s))$ . How many branches does the RL have?

2. Determine the asymptote angles  $\phi_q$  as well as their point of intersection  $\sigma_A$ . Recall that:

$$\phi_q = \frac{(1 + 2q)180}{n_p - n_z} \text{ deg}, \forall q = 0, 1, 2, \dots, n_p - n_z - 1$$
$$\sigma_A = \frac{\sum_{i=1}^{n_p} \text{Re}(p_i) - \sum_{j=1}^{n_z} \text{Re}(z_j)}{n_p - n_z}$$

3. Determine any breakaway/break-in points. If none exist, state none!

4. Determine the angle of departure/arrival, if any. Recall that:

$$\text{AoD from a complex pole : } \phi_p = 180 - \sum_i \angle p_i + \sum_j \angle z_j,$$

$$\text{AoA at a complex zero : } \phi_z = 180 + \sum_i \angle p_i - \sum_j \angle z_j$$

5. Sketch the root locus—no need to find the crossings with the  $j\omega$  axis.