**Root Locus Rules**

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**Number of Branches**
There is one branch for each pole of the open-loop transfer function \( KG(s)H(s) \).

**Starting Points**
The branches of the root locus begin at the poles of \( KG(s)H(s) \).

**Ends of Branches**
The branches of the root locus end at the zeros of \( KG(s)H(s) \).
These zeros may be finite or infinite.

**On the Real Axis**
The root locus exists on the real axis at every point which has an odd number of poles and/or zeros on the axis to its right.

**Symmetry**
The root locus is always symmetrical with respect to the real \((\sigma, \text{horizontal})\) axis.

**Asymptotes**
The number of asymptotes is \((\#p - \#z)\), the number of poles minus the number of zeros.

**Asymptote Angles**
The asymptote angles are found by
\[
\theta_A = \frac{\pi(1 + 2k)}{\#p - \#z}, \quad k = 0, 1, 2, \ldots
\]

**Asymptote Center**
All the asymptotes radiate from a center point at
\[
\sigma_A = \frac{\Sigma(\sigma_p) - \Sigma(\sigma_z)}{\#p - \#z}
\]
where each \( \sigma_p \) is the real part of the coordinate of a pole and each \( \sigma_z \) is the real coordinate of a zero.

**Breakaway/Reentry**
Breakaway occurs at a local maximum of \( K \), and reentry occurs at a local minimum of \( K \). These points can be determined by solving
\[
\frac{dK}{d\sigma} = 0
\]
where \( \sigma \) is a real value of \( s \) along the real axis.

**Finding the Gain**
The gain at any point \( s_o \) on the root locus may be found by the following formula:
\[
K = \frac{1}{|G(s_o)H(s_o)|}
\]