| Table 4.1 Basic Root Locus Principles |

1. The branches of the locus are continuous curves that start at each of the $n$ poles of $GH$, for $K = 0$. As $K$ approaches $+\infty$, the locus branches approach the $m$ zeros of $GH$. Locus branches for excess poles extend infinitely far from the origin; for excess zeros, locus segments extend from infinity.

2. The locus includes all points along the real axis to the left of an odd number of poles plus zeros of $GH$.

3. As $K$ approaches $+\infty$, the branches of the locus become asymptotic to straight lines with angles

$$\theta = \frac{180^\circ + i360^\circ}{n - m}$$

for $i = 0, \pm 1, \pm 2, \ldots$, until all $n - m$ or $m - n$ angles are obtained, where $n$ is the number of poles and $m$ is the number of zeros of $GH$.

4. The starting point of the asymptotes, the centroid of the pole–zero plot, is on the real axis at

$$\sigma = \frac{\sum \text{pole values of } GH - \sum \text{zero values of } GH}{n - m}$$

5. Loci leave the real axis at a gain $K$ that is the maximum $K$ in that region of the real axis. Loci enter the real axis at the minimum value of $K$ in that region of the real axis. These points are termed breakaway points and entry points, respectively. A pair of locus segments leave or enter the real axis at angles of $\pm90^\circ$.

6. The angle of departure $\phi$ of a locus branch from a complex pole is given by

$$\phi = -\sum \text{other } GH \text{ pole angles} + \sum GH \text{ zero angles} + 180^\circ$$

The angle of approach $\phi'$ of a locus branch to a complex zero is given by

$$\phi' = \sum \text{GH pole angles} - \sum \text{other } GH \text{ zero angles} - 180^\circ$$

where each $GH$ pole angle and $GH$ zero angle is calculated to the complex pole for $\phi$ and to the complex zero for $\phi'$.

If the complex pole or zero is of order $m$, the $m$ angles of departure and approach are given by

$$\phi = -\sum \text{other } GH \text{ pole angles} + \sum GH \text{ zero angles} + (1 + 2i)180^\circ$$

$$\phi' = \sum \frac{GH \text{ pole angles} - \sum \text{other } GH \text{ zero angles} - (1 + 2i)180^\circ}{m}$$

for $i = 0, 1, 2, \ldots, (m - 1)$. 