→ Let $G(s)H(s) = \dfrac{K}{(s+1)(s+2)}$

→ Characteristic eqn is $1 + G(s)H(s) = 0$

$$1 + \frac{K}{(s+1)(s+2)} = 0$$

$$s^2 + 3s + 2 + K = 0$$

→ The roots of this equation will change if K is changed.

→ In other words the location of poles of the closed loop transfer function will vary as the parameter K is varied.

THE ROOT LOCUS METHOD

- The closed loop poles are the roots of the characteristic equation.
- Finding them requires factoring the characteristic equation.
- This is in general laborious if the degree of the characteristic equation is three or higher.
- The classical techniques of factoring polynomials are not convenient because as the gain of the open loop transfer function varies the computations must be repeated.
- The root locus method is one in which the roots of the characteristic equation are plotted for all values of a system parameter.
- The roots corresponding to a particular value of this parameter can then be located on the resulting graph.
- The parameter is usually the gain but any other variable of the open loop transfer function may be used.

⊛ The locus of the roots of the characteristic equation of the closed loop system as the gain is varied from $-\infty$ to ∞ gives the method its name.

⊛ Let $F(s) = (s^n + a_1 s^{n-1} + \cdots\cdots + a_{n-1} s + a_n) + K(s^m + b_1 s^{m-1} + \cdots\cdots + b_{m-1} s + b_m) = 0$

where K is the parameter considered to vary between $-\infty$ and ∞.

a) The root loci are the portion of the loci when K assumes positive values. ie $0 \leq K < \infty$

b) The complementary root loci are the portion of the loci when K assumes negative values ie $-\infty < K \leq 0$

c) Root contours: loci of the roots when more than one parameter varies.

⊛ The complete root loci refers to the combination of the root loci and the complementary root loci.