Type 9: Properties of Root-Locus

For Concept, refer to Control Systems K-Notes, Root Locus Technique

Common Mistake:
Try to remember clearly how to distinguish between Breakaway and Break-in points.

Sample Problem 9:

The transfer function of this system is $G(s)=\frac{K(s^2-2s+2)}{(s+2)(s+3)}$.The break point is

(A) Break-away at s =- 1.29
(B) Break-in at s =- 2.43
(C) Break-away at s =- 2.43
(D) Break-in at s =- 1.29

Solution: (C) is correct option
The point, at which multiple roots are present, are known as break point. These are obtained from:

$$\frac{dK}{ds}=0$$

Here, characteristic equation is

$$1+G(s)H(s)=0$$

$$1+\frac{K(s^2-2s+2)}{(s+2)(s+3)}=0 \qquad \Rightarrow K=\frac{-(s+2)(s+3)}{(s^2-2s+2)}=\frac{-(s^2+5s+6)}{(s^2-2s+2)}$$

Now, differentiating eq(1) w.r.t s and equating zero we have

$$\frac{dK}{ds}=\frac{-(s^2-2s+2)(2s+5)+(s^2+5s+6)(2s-2)}{(s^2-2s+2)^2}=0$$

$$7s^2+8s-22=0$$

which gives s=+1.29 and s=-2.43 out of which s=-2.43 is break-away point

Unsolved Problems:

Q.1 The open loop transfer function of a system is $G(s)=\frac{K}{s(s+4)(s^2+4s+8)}$ the value of k at (s = -2) in the root locus is

(A) 4 (B) 8 (C) 16 (D) 32

Q.2 The OLTF of a unity feedback control system is $G(s)=\frac{K}{(s+1)(s^2+4s+5)}$.The angle of departure at the pole $(-2-j1)$ is

(A) $+60^0$ (B) -60^0 (C) $+45^0$ (D) -45^0

Q.3 A unity feedback system has open loop poles at s = $-2 \pm j2$, s = -1, and s = 0; and a zero at s = -3. The angle made by the root locus asymptotes with the real and the point of Intersection of the asymptotes are

(A) $(60^0, -60^0, 180^0)$ and $-3/2$ (B) $(60^0, -60^0, 180^0)$ and $-2/3$

(C) $(45^0, -45^0, 180^0)$ and $-2/3$ (D) $(45^0, -45^0, 180^0)$ and $-4/3$

Q.4 Consider the points S_1 = -3 + j4 and S_2 = - 3 -j2 in the S – plane, then for a system with the open loop transfer function $G(s)H(s) = \frac{K}{(s+1)^4}$

(A) S_1 is on the root locus, but not S_2 (B) S_2 is on the root locus, but not S_1

(C) Both S_1 and S_2 are on the root locus (D) Neither S_1 nor S_2 is on the root locus

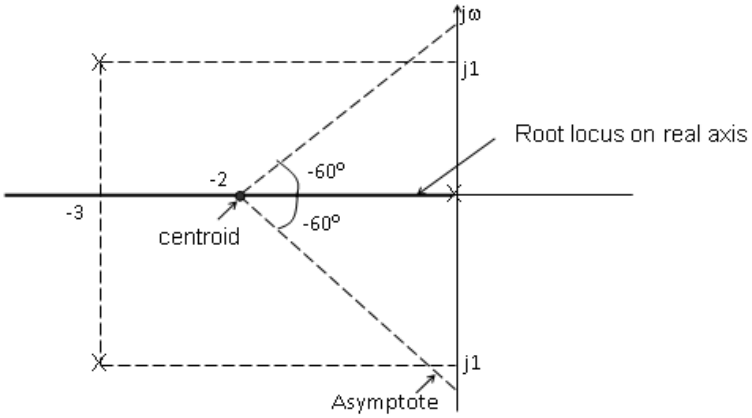
Q.5 Figure shows the asymptote, root locus on real axis and location of poles and centroid. Break-in point of the root locus is

(A) -3

(B) -2

(C) -1.18

(D) -2.82



Q.6 OLTF of an unity feedback system is $\frac{K(s+1)}{s(s-1)}$. For complex roots, the RLD is circle of centre, whose coordinates are

(A) – 0.5, 0 (B) 1, 0 (C) $-$ 1.5, 0 (D) $-$ 1, 0