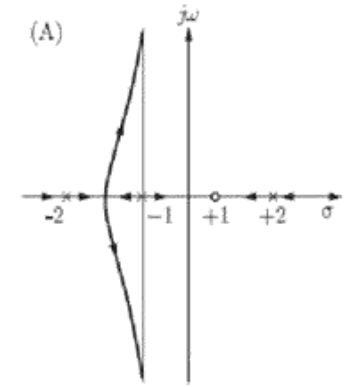
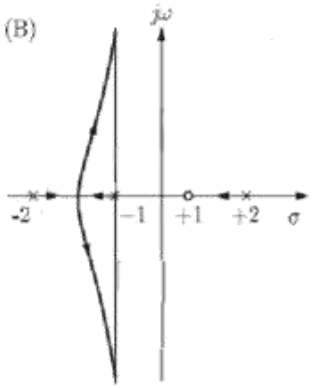
Type 5: Root-Locus Technique

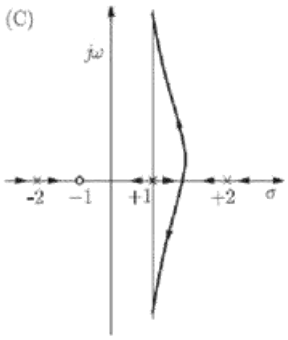
For Concept, refer to Control Systems K-Notes, Root Locus Technique

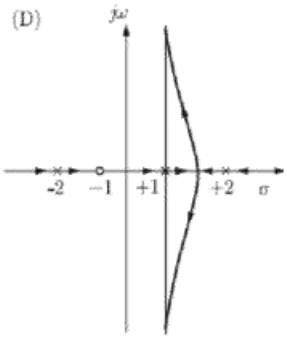
Common Mistake:
For positive feedback the properties of root-locus are reversed. Refer GATE-2014 EE-01 Solutions Ques-18

Sample Problem 5:
A closed-loop system has the characteristic function $(s^2 - 4)(s + 1) + K(s - 1) = 0$. Its root locus plot against *K* is









Solution: (C) is correct option

Closed loop transfer function of the given system is,

$$T(s) = \frac{s^2 + 4}{(s+1)(s+4)}$$

$$T(j\omega) = \frac{j\omega^2 + 4}{(j\omega+1)(j\omega+4)}$$

If system output is zero

$$|T(j\omega)| = \frac{|4-\omega^2|}{|(j\omega+1)(j\omega+4)|} = 0$$

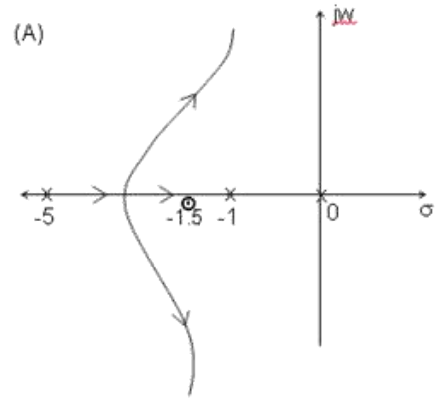
$$4-\omega^2 = 0$$

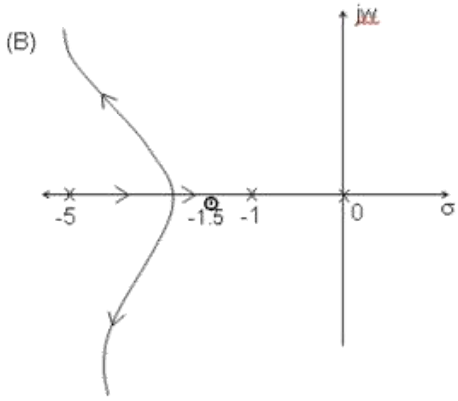
$$\omega^2 = 4$$

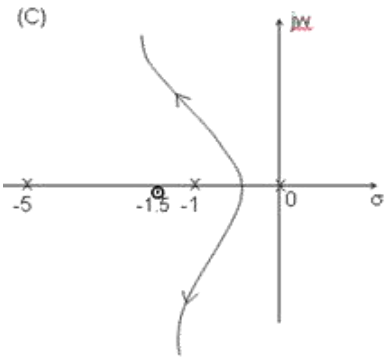
$$\omega = 2 \text{ rad/sec}$$

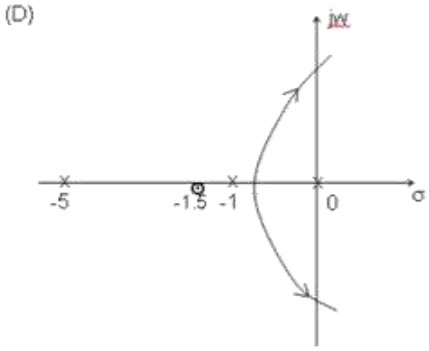
Unsolved Problems:

Q.1 Which one of the following is the root locus of a open loop transfer function of $G(s)H(s) = \frac{K(s+1.5)}{s(s+1)(s+5)}$

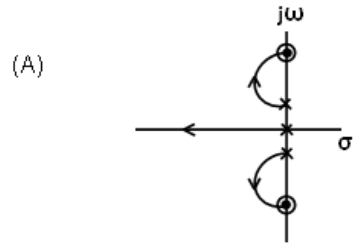


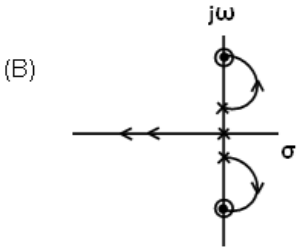




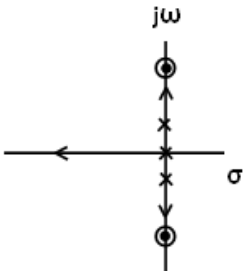


Q.2. OLTF of an unity feedback system is $\frac{K(s^2+10)}{s(s^2+4)}$. The RLD is





(C)



(D) None of the above

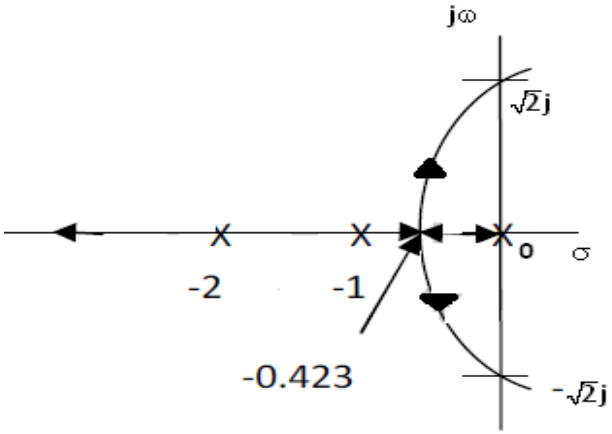
Q.3 The root locus plot for a system, with transfer function $\frac{2}{s(s+1)(s+2)}$, is shown in Figure. A unity feedback proportional control system is built using this system. The maximum possible controller gain, for which the unity feedback system is stable, is approximately

(A) 6.0

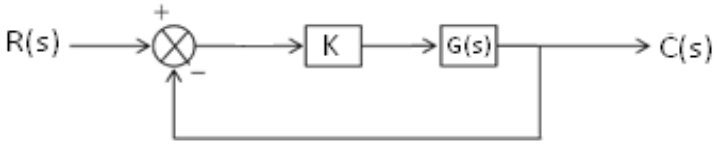
(B) 3.0

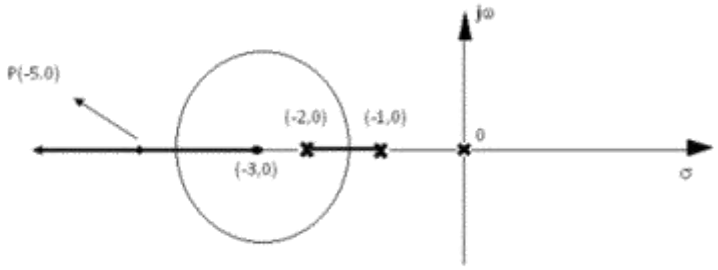
(C) 0.4

(D) 0.2



Q.4 A unity feedback system is shown in Fig. below. The root-locus of its characteristic equation is shown in Fig. below

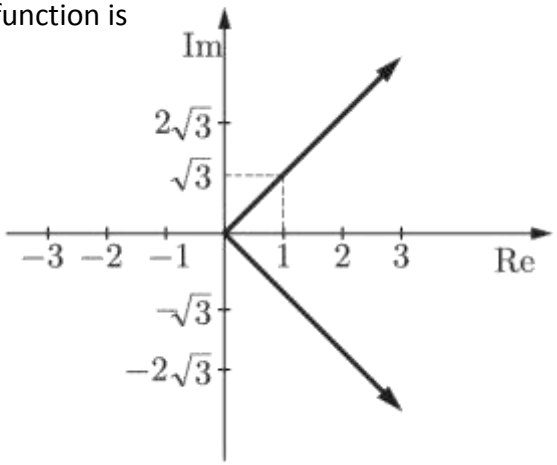




If P (-5, 0) is a point on the root-locus, the variable parameter K of the system at P is?

(A) 2 (B) 4 (C) 6 (D) 8

Q.5 Figure shows the root locus plot (location of poles not given) of a third order system whose open loop transfer function is



(A) $\frac{K}{s^3}$

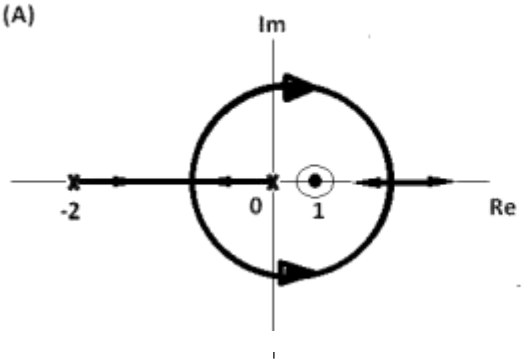
(B) $\frac{K}{s^2(s+1)}$

(C) $\frac{K}{s(s^2+1)}$

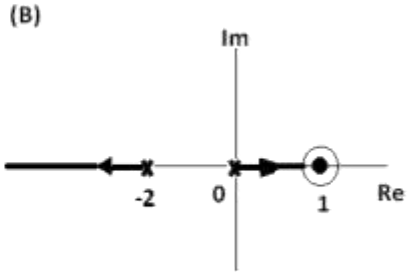
(D) $\frac{K}{s(s^2-1)}$

Q.6 RLD of the system with loop TF $\frac{K(1-s)}{s(s+2)}$, when K is varied from 0 to ∞ is

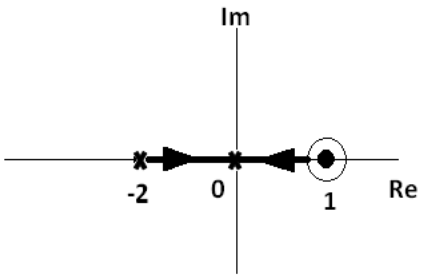
(A)



(B)



(C)



(D) None of these