# GATE 2022[EE]-19

EE23BTECH11066 - Yakkala Amarnath Karthik

**Question:**

The open loop transfer function of a unity gain negative feedback system is given by $G(s) = \frac{k}{s^2+4s-5}$. The range of k for which the system is stable,is (GATE EE 2022)

**Solution:**

| Variable | Description | value |
|---|---|---|
| $G(s)$ | Open loop transfer function | $\frac{k}{s^2+4s-5}$ |
| 1+G($s$) | Characteristic equation | 0 |

TABLE I
A Table with input parameters

from TableI
Characteristic equation:

$$1 + G(s) = 0 \tag{1}$$

$$\implies 1 + \frac{k}{s^2+4s-5} = 0 \tag{2}$$

$$\implies s^2 + 4s + (k-5) = 0 \tag{3}$$

By routh table analysis, for a stable system:

| | | |
|---|---|---|
| $s^2$ | 1 | $k-5$ |
| $s^1$ | 4 | 0 |
| $s^0$ | $\frac{4(k-5)-0}{4}$ | 0 |

$$\frac{4(k-5)-0}{4} > 0 \tag{4}$$

$$k - 5 > 0 \tag{5}$$

$$\implies k > 5 \tag{6}$$

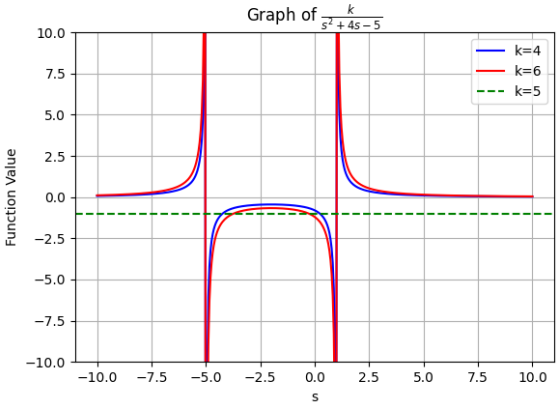


Fig. 1. Graph showing $k < 5, k = 5, k > 5$