

GATE 2022 IN 15

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Question GATE 22 IN 15 :

A unity-gain negative-feedback control system has a loop-gain $L(s)$ given by

$$L(s) = \frac{6}{s(s-5)} \quad (1)$$

The closed loop system is _____

- 1) Causal and stable
- 2) Causal and unstable
- 3) Non-causal and stable
- 4) Non-causal and unstable

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Solution:

From Table 4, the transfer function of the

Parameter	Description	Value
$L(s)$	Forward loop transfer function	$\frac{6}{s(s-5)}$
$H(s)$	Feedback path transferfunction	1
$T(s)$	Transfer function	$\frac{L(s)}{1+L(s)H(s)}$

TABLE 4
PARAMETER TABLE

system is given by,

$$T(s) = \frac{\frac{6}{s(s-5)}}{1 + \frac{6}{s(s-5)}} \quad (2)$$

$$= \frac{6}{s^2 - 5s + 6} \quad (3)$$

The poles of the system are given by the roots of the denominator of transfer function,

$$s^2 - 5s + 6 = 0 \quad (4)$$

\therefore The poles of the system are $s = 2$ and $s = 3$.

As the poles are positive, the output will

increase without bound, causing the system to be unstable.

The transfer function of the system is ,

$$T(s) = \frac{6}{(s-2)(s-3)} \quad (5)$$

Clearly, it is dependent only on the past values. Hence, the system is causal.

Thus the correct option is B. The system is causal and unstable.

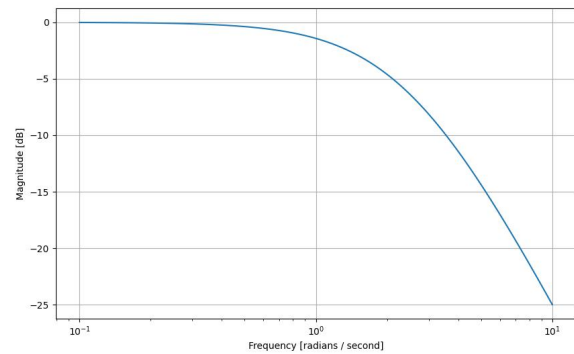


Fig. 4. Magnitude plot for the transfer function

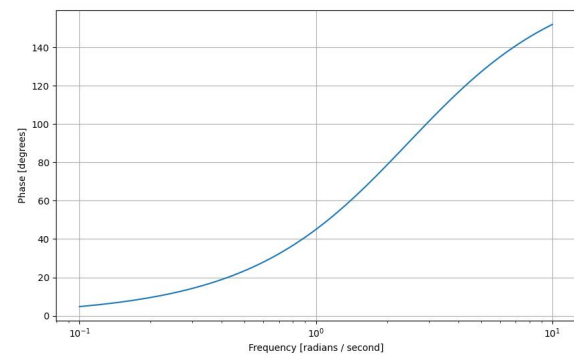


Fig. 4. Phase plot for the transfer function