

### 11.3 Closed-Loop Transfer Function

The closed-loop should have an output  $y(t) \leq 0.05$  for reference commands  $n(t) = 10 \sin(\omega t)$  with  $\omega \geq 1000$  rad/sec. This means that  $|T(j\omega)| \leq A$  for  $\omega \geq B$  rad/sec. What is the value of  $A$  and  $B$ ?

**Solution :**

$(A, B) = (0.005, 1000)$ .

Steps:

We have  $y(t) = -10|T(j\omega)| \sin(\omega t + \angle T(j\omega))$ .

Since  $y(t) \leq 0.1$  for  $\omega \geq 1000$  rad/sec, we must have:

$$|T(j\omega)| \leq \frac{0.05}{10} = 0.005$$

for  $\omega \geq 1000$  rad/sec.

**GPT Answer :**

The system's response  $y(t)$  to a reference command must be less than or equal to 0.05 for  $n(t) = 10 \sin(\omega t)$ , where  $\omega \geq 1000$  rad/sec. This condition translates to  $|T(j\omega)| \leq 0.005$  for  $\omega \geq 1000$  rad/sec. Therefore,  $A = 0.005$  and  $B = 1000$ .

**Confidence Level: 95%**

**Correct**

**Claude Answer:**

Let's break this down step by step:

- 1) The output is  $y(t) = T(j\omega) \cdot n(t)$ , where  $T(j\omega)$  is the closed-loop transfer function.
- 2) We are given that  $n(t) = 10 \sin(\omega t)$  and we want  $y(t) \leq 0.05$  for  $\omega \geq 1000$  rad/sec.
- 3) Therefore, we can write:

$$|T(j\omega) \cdot 10 \sin(\omega t)| \leq 0.05 \text{ for } \omega \geq 1000 \text{ rad/sec}$$

- 4) The maximum value of  $|\sin(\omega t)|$  is 1, so we can simplify this to:

$$|T(j\omega)| \cdot 10 \leq 0.05 \text{ for } \omega \geq 1000 \text{ rad/sec}$$

- 5) Dividing both sides by 10:

$$|T(j\omega)| \leq 0.005 \text{ for } \omega \geq 1000 \text{ rad/sec}$$

- 6) So, comparing this to  $|T(j\omega)| \leq A$  for  $\omega \geq B$  rad/sec, we can see that:

$$A = 0.005 \text{ and } B = 1000 \text{ rad/sec}$$

Therefore, the values are: -  $A = 0.005$  -  $B = 1000 \text{ rad/sec}$

**Confidence level: 95%**

**Correct**