

# GATE 2021 BM 46

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**Question:** Consider a unity feedback system with closed loop transfer function

$$\frac{C(s)}{R(s)} = \frac{s + 90}{s^2 + 10s + 90}$$

The steady state error with respect to a unit ramp input is \_\_\_\_\_. (rounded off to one decimal)

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**Solution:**

$$\frac{C(s)}{R(s)} = \frac{s + 90}{s^2 + 10s + 90} \quad (1)$$

where  $C(s)$  is the output and  $R(s)$  is the input. Given that input is unit ramp function:

$$r(t) = tu(t) \quad (2)$$

$$\Rightarrow R(s) = \frac{1}{s^2} \quad (3)$$

$$\Rightarrow C(s) = \frac{s + 90}{s^2 (s^2 + 10s + 90)} \quad (4)$$

$$E(s) = R(s) - C(s) \quad (5)$$

$$= \frac{s^2 + 9s}{s^2 (s^2 + 10s + 90)} \quad (6)$$

Steady state error is:

$$\lim_{s \rightarrow 0} sE(s) = \frac{s + 9}{s^2 + 10s + 90} \quad (7)$$

$$= \frac{1}{10} \quad (8)$$

$\therefore$  steady state error for unit ramp input is 0.1.