

Hard

Assistant Engineer (Electrical), Class 2025

Building Department

The open loop transfer function for a unit feedback system is $G(s) = K/s(sT + 1)$. By what factor the amplitude gain K should be reduced so that the peak overshoot becomes 25%

A

75

B

25

C

20

Correct

D

10

Correct Answer: C

Full Detailed Explanation

Concept & Reasoning The closed-loop characteristic equation is $Ts^2 + s + K = 0$. In standard form $s^2 + 2\zeta\omega_n s + \omega_n^2 = 0$, giving $\omega_n = K/T$ and $2\zeta\omega_n = 1/T$, so $\zeta = 1/(2\sqrt{KT})$. Therefore $K \propto 1/\zeta^2$ for fixed T . Determine ζ from each overshoot and use $K_{\text{new}}/K_{\text{old}} = (\zeta_{\text{old}}/\zeta_{\text{new}})^2$. The strong drop in overshoot requires a substantial reduction in K .
How to Solve It in the Exam Overshoot first; then use $1/K$.
Important Exam Point Use M_p as decimal (0.75, 0.25), not percentage numbers 75 and 25.
Related Revision Path This question sits in the revision path Control Systems → Transient Response → Second-Order Systems.

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