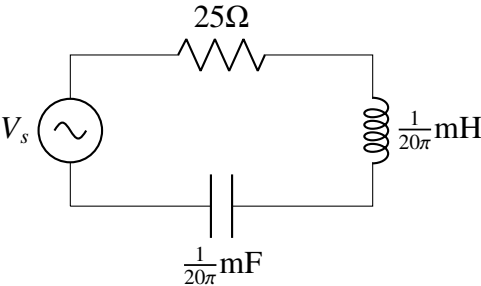


Gate Assignment

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Question

The voltage source $V_s = 10 \sqrt{2} \sin(20000\pi t)$ V has an internal resistance of 50 ohms. The RMS value of the current through R is ___ (in mA) (rounded off to one decimal place).



(GATE IN 2023)

Solution:

Parameter	Value
V_s	$10 \sqrt{2} \sin(20000\pi t)$ V
R	??
R_{internal}	50 ohms
R_{net}	$R + R_{\text{internal}}$

TABLE I
INPUT PARAMETERS

$$V(s) = ZI(s) \quad (1)$$

$$I_{\text{RMS}} = \frac{V_{\text{RMS}}}{|Z|} \cdot \cos(\phi) \quad (2)$$

$$Z = R + R_{\text{internal}} + Ls + \frac{1}{Cs} \quad (3)$$

$$= 50 + 25 + \frac{s}{20000\pi} + \frac{20000\pi}{s} \quad (4)$$

$$Z = 75 \, \Omega \quad (5)$$

$$V_{\text{RMS}} = \frac{10\sqrt{2}}{\sqrt{2}} = 10 \, \text{V} \quad (6)$$

$$\phi = 0 \text{ (no phase difference)} \quad (7)$$

$$\text{Putting } s = j\omega \quad (8)$$

$$= 75 + \frac{20000\pi j}{20000\pi} + \frac{20000\pi}{20000\pi j} \quad (9)$$

$$= 75 + j - j \quad (10)$$

$$= 75 \quad (11)$$

$$I_{\text{RMS}} = \frac{10}{75} \times 1000 = \frac{2000}{15} \approx 133.3 \, \text{mA} \quad (12)$$