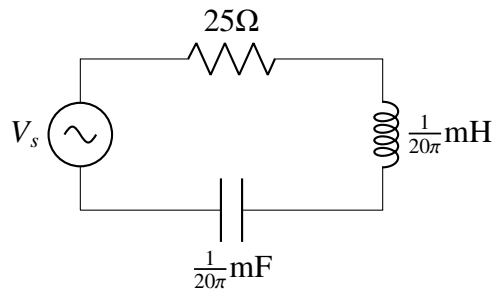


Gate Assignment

SAMMETA SAIPOORNA
EE23BTECH11055

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}	$R + R_{\text{internal}}$
ω	20000π

TABLE I
INPUT PARAMETERS

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

$$\frac{V(s)}{I(s)} = Z = R + R_{\text{internal}} + Ls + \frac{1}{Cs} \quad (2)$$

$$= 50 + 25 + \frac{s}{20000\pi} + \frac{20000\pi}{s} \quad (3)$$

$$V_{\text{RMS}} = \frac{10\sqrt{2}}{\sqrt{2}} = 10 \text{ V} \quad (4)$$

$$\text{Putting } s = j\omega \quad (5)$$

$$\frac{V(j\omega)}{I(j\omega)} = |Z| \cdot e^{\angle Z} \quad (6)$$

$$= 75 + \frac{20000\pi j}{20000\pi} + \frac{20000\pi}{20000\pi j} \quad (7)$$

$$= 75 + j - j \quad (8)$$

$$= 75 \quad (9)$$

$$I_{\text{RMS}} = \frac{V_{\text{RMS}}}{|Z|} \quad (10)$$

$$= \frac{10}{75} \times 1000 = \frac{2000}{15} \approx 133.3 \text{ mA} \quad (11)$$