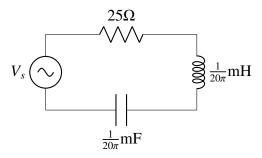
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Gate Assignment

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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:

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

INPUT PARAMETERS

$$V(s) = ZI(s) \tag{1}$$

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

$$= 50 + 25 + \frac{s}{20000\pi} + \frac{20000\pi}{s} \tag{3}$$

$$V_{\rm RMS} = \frac{10\sqrt{2}}{\sqrt{2}} = 10\,\rm V \tag{4}$$

Putting
$$s = j\omega$$
 (5)

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

$$=75 + \frac{20000\pi j}{20000\pi} + \frac{20000\pi}{20000\pi j} \tag{7}$$

$$=75+j-j\tag{8}$$

$$=75\tag{9}$$

$$I_{\rm RMS} = \frac{V_{\rm RMS}}{|Z|} \tag{10}$$

$$= \frac{10}{75} \times 1000 = \frac{2000}{15} \approx 133.3 \,\text{mA} \tag{11}$$

