# GATE - 21 EE (14)

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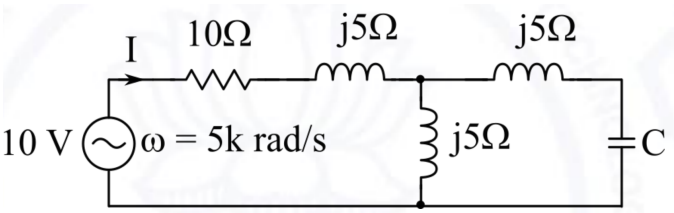
*Question :-*

In the given circuit, the value of capacitor C that makes current I=0 in $\mu F$ is

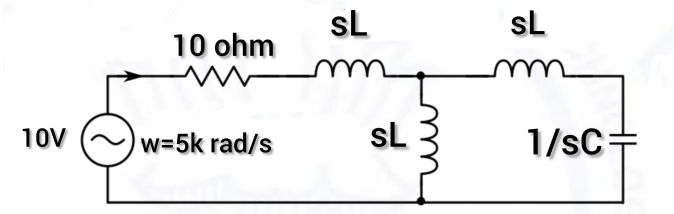



*Solution:-*

| Symbol | Value | Description |
|---|---|---|
| $s$ | $j\omega$ | complex frequency variable |
| $j$ | $\sqrt{-1}$ | imaginary unit |
| $C$ | ? | capacitance |
| $X_L$ | $\omega L = 5\Omega$ | inductive reactance |
| $Z$ | $\infty$ | impedance of circuit |

TABLE I

Using Laplace transform , modified figure is




For $I = 0$ , impedance $(Z) = \infty$

$$Z = 10 + sL + \left(\frac{\left(sL + \frac{1}{sC}\right) \times sL}{sL + \frac{1}{sC} + sL}\right) \tag{1}$$

$$= 10 + sL + \frac{sL + \frac{1}{sC}}{1 + \frac{1}{s^2LC} + 1} \tag{2}$$

For $Z = \infty$ ;

$$2 + \frac{1}{s^2LC} = 0 \tag{3}$$

$$\implies C = \frac{-1}{2s^2L} \tag{4}$$

Refering from table ;

$$C = \frac{-1}{2(j\omega)^2L} \tag{5}$$

$$= \frac{-1}{2\,(\omega L)\,\omega(j)^2} \tag{6}$$

$$= \frac{1}{2\,(\omega L)\,\omega} \tag{7}$$

$$\implies C = 20\mu F \tag{8}$$