Chapter 9, Solution 89.

An industrial load is modeled as a series combination of an inductor and a resistance as shown in Fig. 9.89. Calculate the value of a capacitor C across the series combination so that the net impedance is resistive at a frequency of 2 kHz.

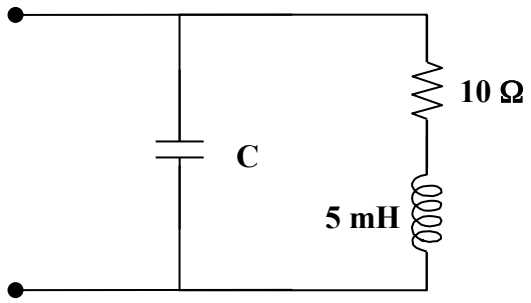

Figure 9.89
For Prob. 9.89.

Solution

Step 1.

There are different ways to solve this problem but perhaps the easiest way is to convert the series R L elements into their parallel equivalents. Then all you need to do is to make the inductance and capacitance cancel each other out to result in a purely resistive circuit.

$X_L = 2x10^3x5x10^{-3} = 10$ which leads to $\mathbf{Y} = 1/(10+j10) = 0.05–j0.05$ or a 20Ω resistor in parallel with a j20Ω inductor. $X_c = 1/(2x10^3C)$ and the parallel combination of the capacitor and inductor is equal to,

$[(-jX_C)(j20)/(-jX_C+j20)]$.

Step 2.

Now we just need to set $X_C = 20 = 1/(2x10^3C)$ which will create an open circuit.

$$C = 1/(20x2x10^3) = \mathbf{25\ \mu F}.$$