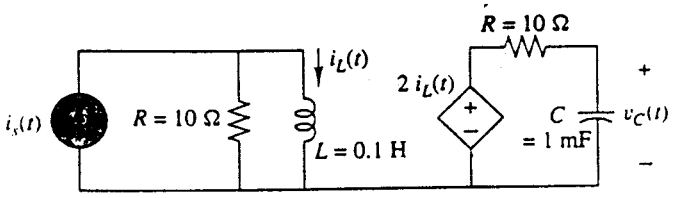
Problem 1:

Compute the steady state voltage $v_c(t)$ across the capacitor for the circuit below when the current through the current source is given by: $i_s(t) = cos(100t)A$.



$\omega = 100 \frac{rad}{s}$

$\omega L = 10\,\Omega$

$$\underline{I}_L = \frac{R}{R + j\omega L}\underline{I}_s = \frac{10}{10 + j10}\underline{I}_s \qquad \underline{I}_s = (1\angle 0^\circ)\,A$$

$$= \frac{1}{1 + j}\underline{I}_s = \frac{1}{\sqrt{2}}\angle -45^\circ$$

$$\underline{V}_c = \frac{\frac{1}{j\omega C}}{\frac{1}{j\omega C} + R}(2\underline{I}_L) \qquad \frac{1}{\omega C} = \frac{1}{10^2 \times 10^{-3}} = 10\,\Omega$$

$$= \frac{-j10}{10 - j10}\frac{2}{\sqrt{2}}\angle -45^\circ$$

$$= \frac{1}{1 + j}\frac{2}{\sqrt{2}}\angle -45^\circ = \left(\frac{1}{\sqrt{2}}\angle -45^\circ\right)\left(\frac{2}{\sqrt{2}}\angle -45^\circ\right)$$

$$\underline{V}_c = (1\angle -90^\circ)\,V$$

$$\rightarrow \quad v_c(t) = \cos(100t - 90^\circ)\,V = \sin(100t)\,V$$