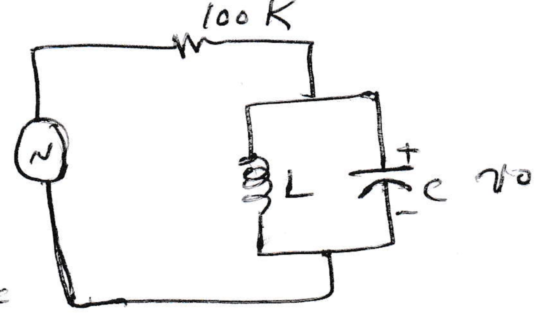
EX for figure below.



$$v_S(t) = \begin{cases} 10 & 0 < t < \pi \text{ msec} \\ 0 & \pi \text{ msec} < t < 2\pi \text{ msec} \end{cases}$$

$L = 1\,H$, $C = 1\,\mu f$

Determine the value of vo(t).

The first step is to find the fourier series for vs(t).

$$f(t) = a_o + \sum_{n=1}^{1} a_n \cos n\omega_o t + b_n \sin n\omega_o t.$$

$T = 2\pi \times 10^{-3}$ and $\omega_o = 1000$

$$a_o = \frac{1}{2\pi \times 10^{-3}} \left[\int_0^{\pi \times 10^{-3}} 10\, dt + \int_{\pi \times 10^{-3}}^{2\pi \times 10^{-3}} 0 \right] = \frac{1}{2\pi \times 10^{-3}} (10t - 0) \Big|_0^{\pi \times 10^{-3}}$$

$a_o = 5$ volt

$$a_n = \frac{1}{T} \int_0^T f(t) \cdot \cos n\omega_o t$$

$$a_n = \frac{1}{2\pi \times 10^{-3}} \int_0^{\pi \times 10^{-3}} 10 \cdot \cos(n \times 1000)\, t$$

$$= \frac{10}{2\pi \times 10^{-3}} * \frac{\sin(1000n)t}{1000n} \Big|_0^{\pi \times 10^{-3}}$$

$$= \frac{5}{2\pi n} \left[\sin(1000 * n * \pi * 10^{-3}) - \sin 0 \right]$$

$= 0$

$$bn = \frac{2}{2\pi \times 10^{-3}} \int_0^T f(t) \sin(1000n\, t)\, dt$$

$$= \frac{1}{\pi \times 10^{-3}} \left[\int_0^{\pi \times 10^{-3}} 10 \sin(1000t)\, dt + 0 \right\}$$

$$= -\frac{1}{\pi \times 10^{-3} \times 10^{3} n} \times 10 \cos(1000t) \Big|_0^{10^{-3}}$$

$$= \frac{-10}{n\pi} \left(\cos(n\pi) - 1 \right)$$

Thus, $bn = \begin{vmatrix} \frac{20}{n\pi} & \text{for } n = \text{odd} \\ 0 & \text{for } n = \text{even} \end{vmatrix}$

therefor, $v_s(t) = \left[5 + \sum_{K=1}^{\infty} \frac{20}{(1+2K)\pi} \sin(1000(1+2K)t) \right]$ volt

for d.c term, $v_o = 0$ since the inductor looks like a short for d-c.

For all the other values of n, $v_o = \frac{v \times Z}{Z+R}$

$$v_o = \frac{\frac{20}{n\pi}}{10^5 + \frac{L/C}{j(wL - \frac{1}{(wC)})}} \left(\frac{L/C}{j(wL - \frac{1}{(wC)})} \right), \ w = 1000n \text{ for odd}$$

$$= \frac{\frac{20L}{n\pi C}}{j10^5 (wL - \frac{1}{wC}) + \frac{L}{C}} = \frac{\frac{20 \times 10^6}{n\pi}}{j10^5 (1000n - \frac{1000}{n}) + 10^6}$$

for $n=1$, $w=1000$, therefore $v_o = \frac{20}{\pi}$

for $n=3$, $w=3000$, therefore,

the value of $L \parallel C = \frac{L/C}{j(wL - \frac{1}{wC})} = \frac{1000}{j2667}$

$= -j0.375\ \Omega$

The value of impedance is so much smaller than the value of the resister that can neglect this term and all of the others.

thus,

$v_o = \frac{20}{\pi} \sin(1000t)$ volts.