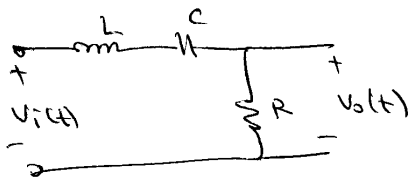
EE322 Fall 08 Homework Problem Set 34 (PS34)

Be sure to show your work.

1. Text, Problem 12-7. Use MATLAB for your answers where possible.

2. Text, Problem 12-28d. Use MATLAB to plot your result using a frequency in rad/sec for ω = –500 rad/sec to 500 rad/sec.

12.7



(a) at $w = 0 \Rightarrow Z_L = 0$ & $Z_C = \infty$

$\Rightarrow V_o(t) = 0$

at $w = \infty \Rightarrow Z_L = \infty$ & $Z_C = 0$

$\Rightarrow V_o(t) = 0$

BPF.

(b) $$H(jw) = \frac{R}{R + jLw + \frac{1}{jCw}} =$$

$$\frac{(jw)RC}{(jw)^2 LC + (jw)RC + 1} = \frac{(jw)RC/LC}{(jw)^2 + (jw)RC/LC + \frac{1}{LC}} = \frac{(jw)R/L}{(jw)^2 + (jw)\frac{R}{L} + \underbrace{\frac{1}{LC}}_{w_0^2}}$$

$$w_0^2 = LC \Rightarrow f_0 = \frac{w_0}{2\pi} = \frac{1}{2\pi\sqrt{LC}}$$

(c) Resonance frequency $f_{max} = f_0 = \frac{1}{2\pi\sqrt{10^{-1}\, 5\cdot 10^{-6}}} = 225$ Hz

$$H(jw_0) = \frac{jw_0 R/L}{-w_0^2 + (jw_0)\frac{R}{L} + w_0^2} = 1$$

$\Rightarrow |H(jw_0)| = 1$ and $\angle H(jw_0) = 0$

(d) $$|H(jw)| = \frac{w \cdot R/L}{\sqrt{\left(\frac{1}{LC} - w^2\right)^2 + \left(\frac{R}{L}\right)^2}} = \frac{2\pi \cdot 100 \quad 50/0.1}{\sqrt{\left(\frac{1}{10^{-1}\, 5\cdot 10^{-6}} - 2\pi\cdot 100\right)^2 + \left(\frac{50}{0.1}\right)^2}}$$

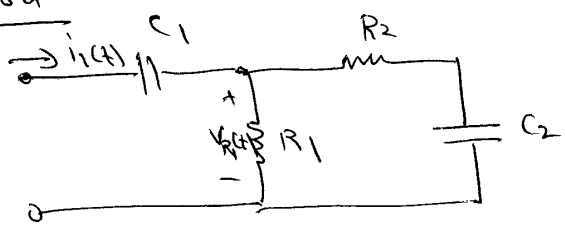
@ $w = 2\pi \cdot 100$

$= 0.196$

$|H(j0)| = 0$

$|H(\infty)| = 0$

12.28d



$$H(j\omega) = \frac{V_{R_1}(\omega)}{I_1(\omega)}$$

Let $Z_2 = R_2 + \frac{1}{j\omega C_2}$

and $Z_1 = R_1 \parallel Z_2$

$$\Rightarrow V_{R_1} = I_1 \cdot Z_1 \Rightarrow H(j\omega) = Z_1 = \frac{R_1 \cdot \left(R_2 + \frac{1}{j\omega C_2}\right)}{R_1 + R_2 + \frac{1}{j\omega C_2}}$$

$$= \frac{R_1 \left(1 + j\omega R_2 C_2\right)}{1 + j\omega C_2 \left(R_1 + R_2\right)}$$

$$= \frac{10^4 \left(1 + j\omega \cdot 10^4 \cdot 10^{-6}\right)}{1 + j\omega 10^{-6} \left(10^4 + 10^4\right)} = \frac{10^4 \left(1 + j\omega \cdot 10^{-2}\right)}{1 + (j\omega)\, 2 \cdot 10^{-2}}$$

$$= \frac{10^4 \left(1 + \frac{j\omega}{100}\right)}{\left(1 + \frac{j\omega}{50}\right)}$$