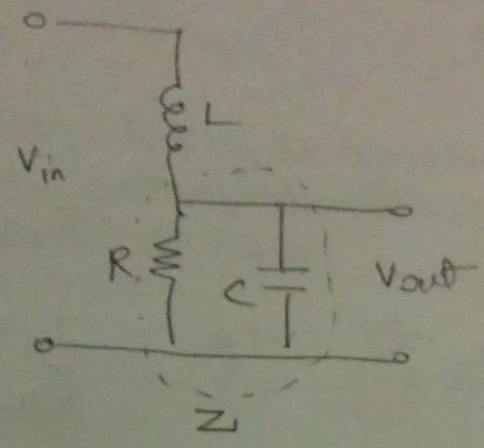
1.



$$Z = R \parallel 1/j\omega C$$

$$= \frac{R \times \frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{R}{1 + j\omega RC}$$

By voltage division rule,

$$V_{out} = \frac{Z}{Z + j\omega L} \cdot V_{in}$$

$$\therefore H(\omega) = \frac{V_{out}(\omega)}{V_{in}(\omega)} = \frac{Z}{Z + j\omega L} = \frac{\frac{R}{1 + j\omega RC}}{\frac{R}{1 + j\omega RC} + j\omega L}$$

$$= \frac{R}{R + j\omega L + (j\omega)^2 RLC}$$

$$= \frac{R}{R + j\omega L - \omega^2 RLC}$$

2. $H(\omega) = \dfrac{1}{1+j\omega\tau_1} \cdot \dfrac{1}{1+j\omega\tau_2}$ $(\tau_2 > \tau_1)$

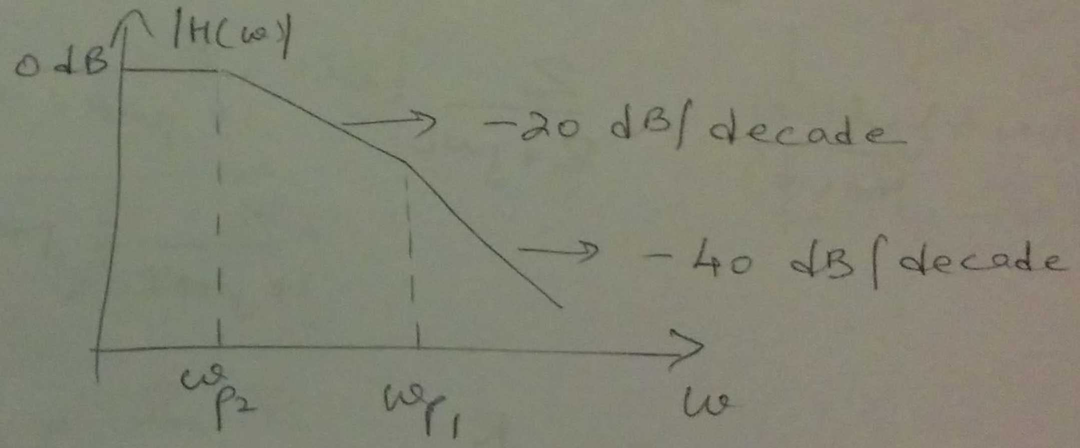
poles at $|\omega\tau_1| = 1 \Rightarrow \omega_{p_1} = \dfrac{1}{\tau_1}$

$|\omega\tau_2| = 1 \Rightarrow \omega_{p_2} = \dfrac{1}{\tau_2}$

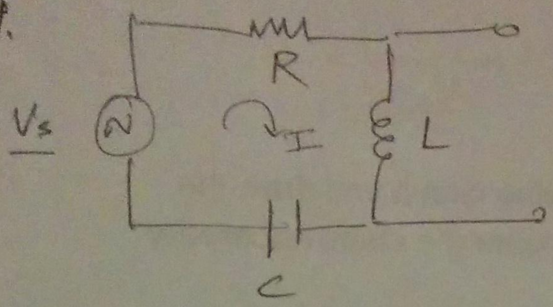
Since, $\tau_2 > \tau_1$

$\omega_{p_2} < \omega_{p_1}$

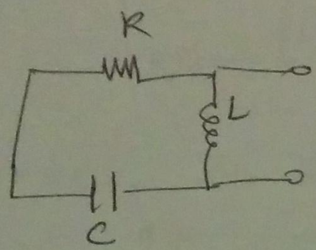
$|H(0)| = 1$ or 0 dB



4.



$\underline{\underline{Z_{TH}}}$



$$Z_{TH} = \left(R + \frac{1}{j\omega C}\right) \| (j\omega L)$$

$$= \frac{\left(R + \frac{1}{j\omega C}\right)(j\omega L)}{R + \frac{1}{j\omega C} + j\omega L}$$

$$= \frac{\left[(j\omega RC) + 1\right](j\omega L)}{j\omega RC + 1 + (j\omega)^2 CL}$$

$$= \frac{-\omega^2 RCL + j\omega L}{1 + j\omega RC - \omega^2 CL}$$

$\underline{V_{TH} = V_{oc}}$,

$$I = \frac{\underline{V_s}}{R + j\omega L + \frac{1}{j\omega C}} = \frac{(j\omega C)\,\underline{V_s}}{1 + j\omega RC + (j\omega)^2 LC}$$

$$V_{TH} = Z_L \cdot I = (j\omega L) I$$

$$= \frac{(j\omega)^2 LC \cdot \underline{V_s}}{1 + j\omega RC + (j\omega)^2 LC}$$

5. a) $\omega_0 \tau = 1 \Rightarrow \omega_0 = 1/\tau$

$\omega_1 = 0.01\tau_1^{-1} = 0.01\omega_0$

$\omega_2 = 10\tau^{-1} = 10\omega_0$

from Bode Plot,

$|H(\omega_1)| = 0 \text{ dB} = 1 V$

$|H(\omega_2)| = -20 \text{ dB} = 10^{-20/20} = 10^{-1} = 0.1 V$

$\angle H(\omega_1) = 0$

$\angle H(\omega_2) = -90^\circ$

$\therefore V_{out}(t) = Re\left[1.|H(\omega_1)| e^{j\angle H(\omega_1)} \cdot e^{j\omega_1 t} + 1.|H(\omega_2)|.e^{j\angle H(\omega_2)} \cdot e^{j\omega_2 t}\right]$

$= Re\left[1.e^0.e^{j\omega_1 t} + 1\times 0.1 e^{+90j} \cdot e^{j\omega_2 t}\right]$

$= \cos\omega_1 t + 0.1\cos(\omega_2 t - 90^\circ)$

b) $\omega_1 = 0.1\omega_0$

$\omega_2 = 100\omega_0$

from Bode Plot,

$|H(\omega_1)| = 0 \text{ dB} = 1V$

$|H(\omega_2)| = -40\text{dB} = 10^{-40/20} = 0.01$

$\angle H(\omega_1) = 0$

$\angle H(\omega_2) = -90^\circ$

$\therefore V_{out}(t) = Re\left(1.e^0.e^{j\omega_1 t} + 1\times 0.01 e^{-j90^\circ} \cdot e^{j\omega_2 t}\right]$

$= \cos\omega_1 t + 0.01\cos(\omega_2 t - 90^\circ)$