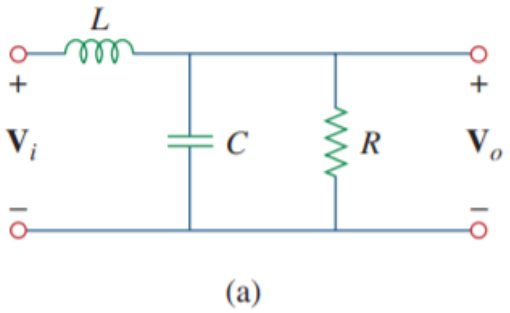
Ve215 Introduction to Circuits
Homework 8

Please name your file as $NAME\_HW8\_STUDENTID$.
In order to receive full marks, you shall write all the intermediate steps of calculation or proof unless otherwise indicated.

Exercise 8.1 (30%) Find the transfer function $H(\omega) = V_o/V_i$ of the circuits.

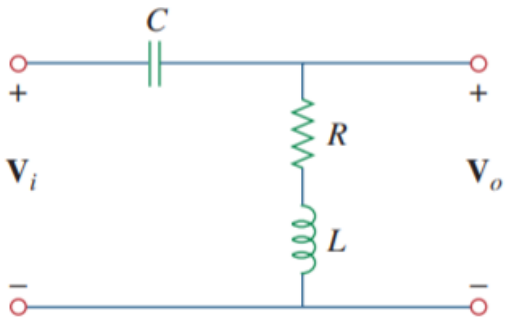


(a)

(a) $$R \parallel \frac{1}{j\omega C} = \frac{R}{1 + j\omega RC}$$

$$\mathbf{H}(\omega) = \frac{\mathbf{V}_o}{\mathbf{V}_i} = \frac{\dfrac{R}{1 + j\omega RC}}{j\omega L + \dfrac{R}{1 + j\omega RC}} = \frac{R}{R + j\omega L(1 + j\omega RC)}$$

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



(b)

(b) $$\mathbf{H}(\omega) = \frac{R + j\omega L}{R + j\omega L + 1/j\omega C} = \frac{j\omega C(R + j\omega L)}{1 + j\omega C(R + j\omega L)}$$

$$\mathbf{H}(\omega) = \frac{\mathbf{-\omega^2 LC + j\omega RC}}{\mathbf{1 - \omega^2 LC + j\omega RC}}$$

Exercise 8.2 (30%) Sketch the bode plots for

$$H(\omega) = \frac{250(j\omega + 1)}{j\omega(-\omega^2 + 10j\omega + 25)}$$

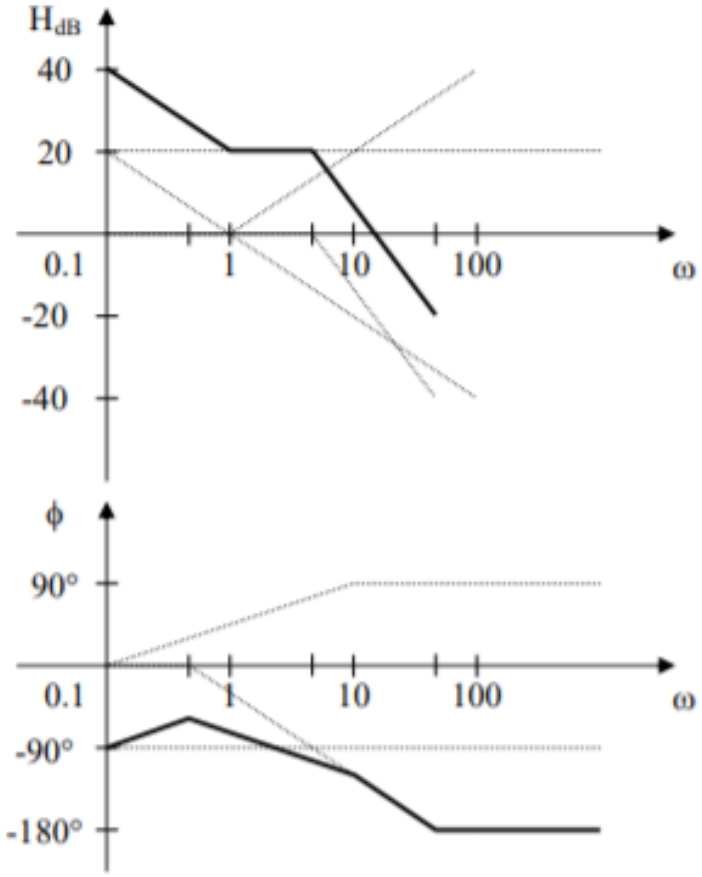
$$\mathbf{H}(\omega) = \frac{250}{25} \frac{1 + j\omega}{j\omega\left(1 + \frac{j\omega 10}{25} + \left(\frac{j\omega}{5}\right)^2\right)}$$

$$H_{dB} = 20\log_{10} 10 + 20\log_{10}|1 + j\omega| - 20\log_{10}|j\omega|$$

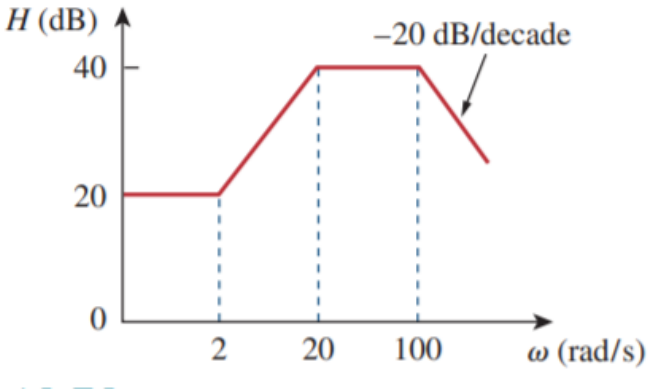
$$- 20\log_{10}|1 + j\omega 2/5 + (j\omega/5)^2|$$

$$\phi = -90° + \tan^{-1}\omega - \tan^{-1}\left(\frac{\omega 10/25}{1 - \omega^2/5}\right)$$

The magnitude and phase plots are shown below.



Exercise 8.3 (30%) Find the transfer function $H(\omega)$ with the Bode magnitude plot



$$20 = 20\log_{10} k \longrightarrow k = 10$$

$$\text{A zero of slope } +20\text{ dB/dec at } \omega = 2 \longrightarrow 1 + j\omega/2$$

$$\text{A pole of slope } -20\text{ dB/dec at } \omega = 20 \longrightarrow \frac{1}{1 + j\omega/20}$$

$$\text{A pole of slope } -20\text{ dB/dec at } \omega = 100 \longrightarrow \frac{1}{1 + j\omega/100}$$

Hence,

$$\mathbf{H}(\omega) = \frac{10(1 + j\omega/2)}{(1 + j\omega/20)(1 + j\omega/100)}$$

$$\mathbf{H}(\omega) = \frac{\mathbf{10^4\,(2 + j\omega)}}{\mathbf{(20 + j\omega)(100 + j\omega)}}$$

Exercise 8.4 (10%) Congratulations! You've finished the last assignment of this course. You can leave whatever you want here. It's good to be with you in VE215. Good luck in the final exam!