Problem 1

In the circuit below, where $L = 2$ mH and $R = 2$ kΩ,

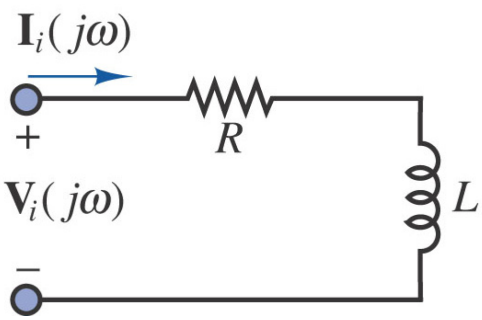
(a) Determine how the input impedance $Z(j\omega) = \dfrac{V_i(j\omega)}{I_i(j\omega)}$ behaves at extremely high and low frequencies.

(b) Find an expression for the impedance.

(c) Show that this expression can be manipulated into the form $Z(j\omega) = R\left[1 + j\dfrac{\omega L}{R}\right]$.

(d) Determine the frequency $\omega = \omega_c$ for which the imaginary part of the expression in part c is equal to 1.

(e) Estimate the magnitude and phase angle of $Z(j\omega)$ at $\omega = 10^5$ rad/s,. 10^6 rad/s, and 10^7 rad/s.



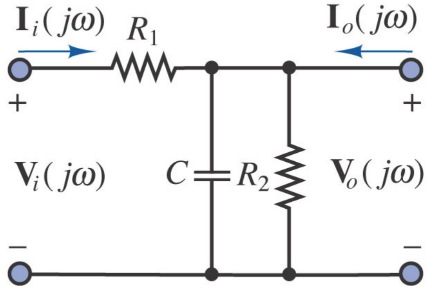
Problem 2

In the circuit below: $R_1 = 1.3$ kΩ, $R_2 = 1.9$ kΩ, and C = 0.5182 μF.

(a) Determine how the voltage transfer function $H_V(j\omega) = \dfrac{V_o(j\omega)}{V_i(j\omega)}$ behaves at extremes of high and low frequencies.

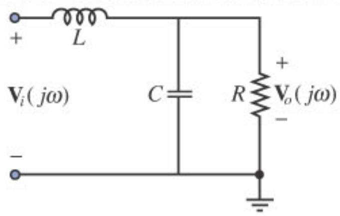
(b) Obtain an expression for the voltage transfer function and show that it can be manipulated into the form $H_v(j\omega) = \dfrac{H_o}{1 + jf(\omega)}$ where $H_0 = \dfrac{R_2}{R_1 + R_2}$ and $f(\omega) = \dfrac{\omega R_1 R_2 C}{R_1 + R_2}$.

(c) Determine the frequency at which $f(\omega) = 1$ and the value of H_0.

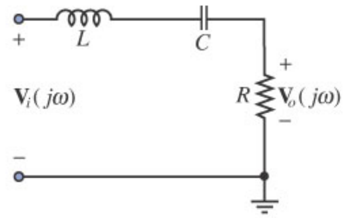


Problem 3

Are the filters shown below low-pass, high-pass, band-pass, or band-stop (notch) filters?



(a)



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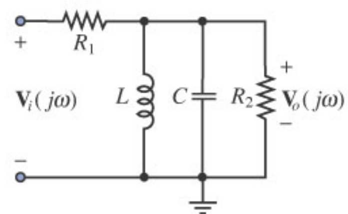
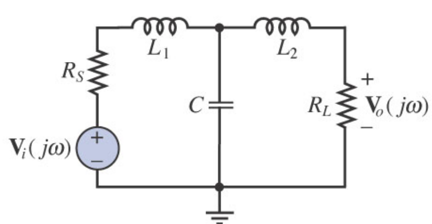


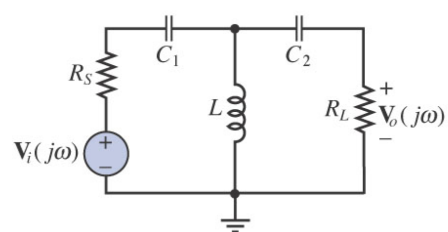
(c)

Problem 4

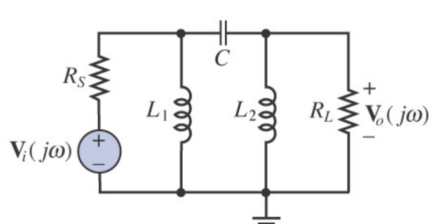
Determine if each of the circuits shown below is a low-pass, high-pass, band-pass, or band-stop (notch) filter.



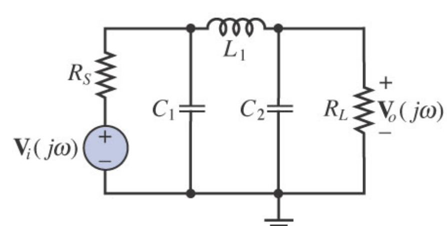
(a)



(c)



(b)



(d)