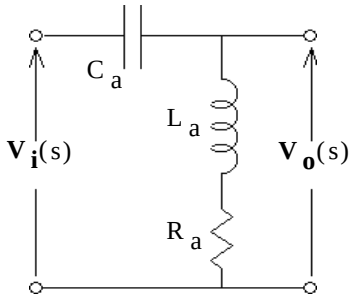
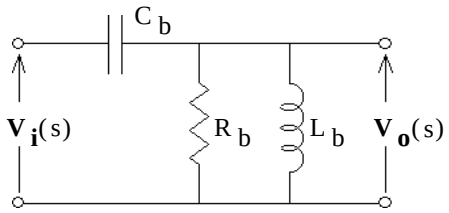
Name: _____ ECE 3510 homework AF1 Due: Mon, 4/15/24 a2

1. Find the input impedance ($\mathbf{Z_{in}(s)}$) and output impedance ($\mathbf{Z_{out}(s)}$) of each of the circuits below.

a)

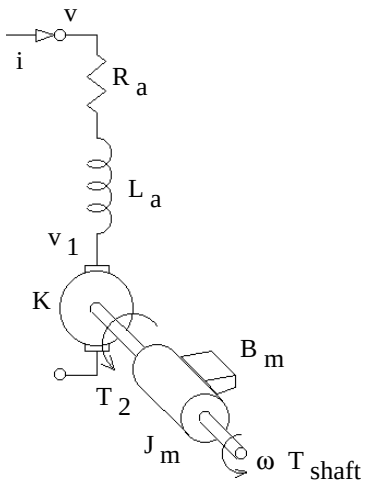


b)

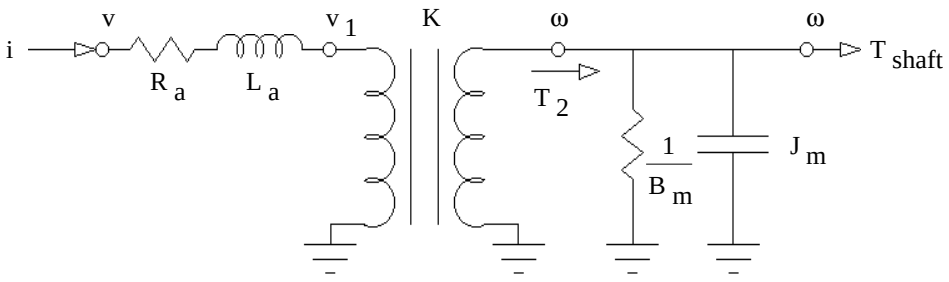


2. Now hook circuit b), above to the output of circuit a). Find the input impedance ($\mathbf{Z_{in}(s)}$) and output impedance ($\mathbf{Z_{out}(s)}$) of the combination circuit.

3. The following is a model of a DC motor. Find the input and output impedances.



$$N = K = \frac{v_1}{\omega} = \frac{T_2}{i}$$



Answers

1. a) $\mathbf{Z_{in}} = \frac{1}{C_a \cdot s} + R_a + L_a \cdot s$ $\qquad \mathbf{Z_{out}} = \frac{\frac{1}{C_a} \cdot s + \frac{R_a}{L_a \cdot C_a}}{s^2 + \frac{R_a}{L_a} \cdot s + \frac{1}{L_a \cdot C_a}}$ $\qquad$ b) $\mathbf{Z_{in}} = \frac{1}{C_b \cdot s} + \frac{1}{\frac{1}{R_b} + \frac{1}{L_b \cdot s}}$

b) $\mathbf{Z_{out}} = \frac{\frac{1}{C_b} \cdot s}{s^2 + \frac{1}{R_b \cdot C_b} \cdot s + \frac{1}{L_b \cdot C_b}}$

2. $\mathbf{Z_{in}} = \frac{1}{C_a \cdot s} + \frac{1}{\frac{1}{R_a + L_a \cdot s} + \frac{1}{\frac{1}{C_b \cdot s} + \frac{1}{\frac{1}{R_b} + \frac{1}{L_b \cdot s}}}}$ $\qquad \mathbf{Z_{out}} = \frac{1}{\frac{1}{\frac{1}{C_a \cdot s + \frac{1}{R_a + L_a \cdot s}} + \frac{1}{C_b \cdot s}} + \frac{1}{R_b} + \frac{1}{L_b \cdot s}}$

3. $\mathbf{Z_{in}} = R_a + L_a \cdot s + \frac{K^2}{B_m + J_m \cdot s}$ $\qquad \mathbf{Z_{out}} = \frac{1}{\frac{K^2}{R_a + L_a \cdot s} + B_m + J_m \cdot s}$