MATHEMATICAL QUESTIONS

Question 1

If the two networks shown in each of Figs. 1 and 2 are equivalent, specify values for L_a, L_b, and L_c. For each equivalent circuit, show that L_a, L_b, and L_c can be non-negative by a proper choice of n

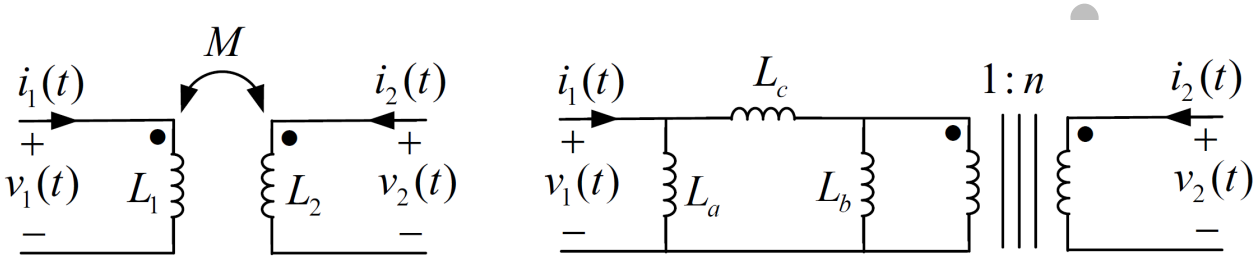

Figure 1: A pair of coupled inductors and its Π equivalent circuit.

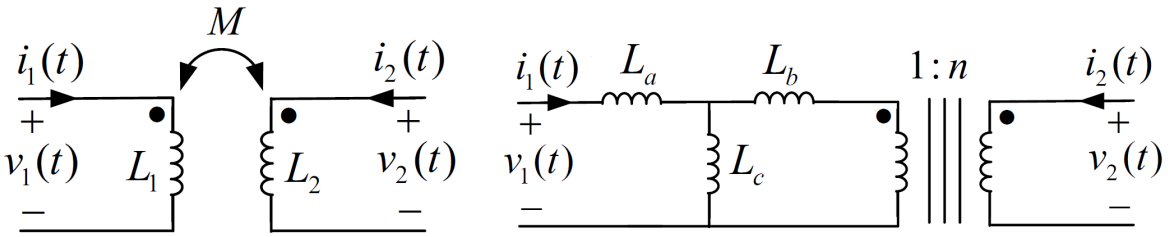

Figure 2: A pair of coupled inductors and its T equivalent circuit.

Question 2

Find the frequency response $H(j\omega) = \frac{V_o(j\omega)}{V_s(j\omega)}$ of the double-tuned circuit shown in Fig. 3.

Question 2 continued on next page...

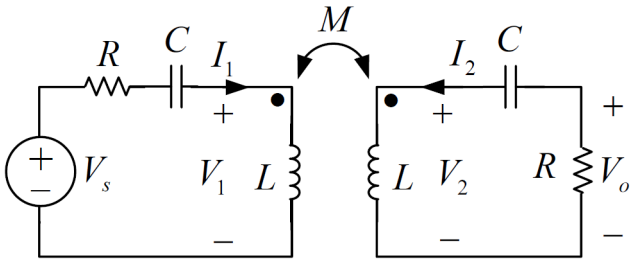

Figure 3: Double-tuned circuit.

Question 3

For the circuit of Fig. 4, find the input impedance Z_{in} seen from the source terminals.

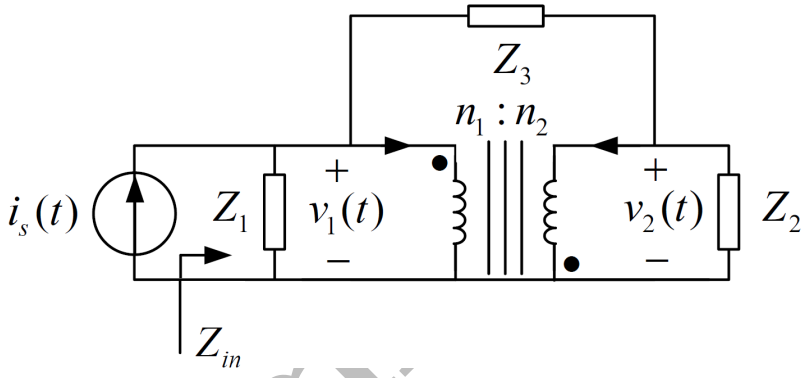

Figure 4: A circuit for which the input impedance is required.

Question 4

Calculate I_x and V_2 as labeled in Fig. 5.

Question 4 continued on next page...

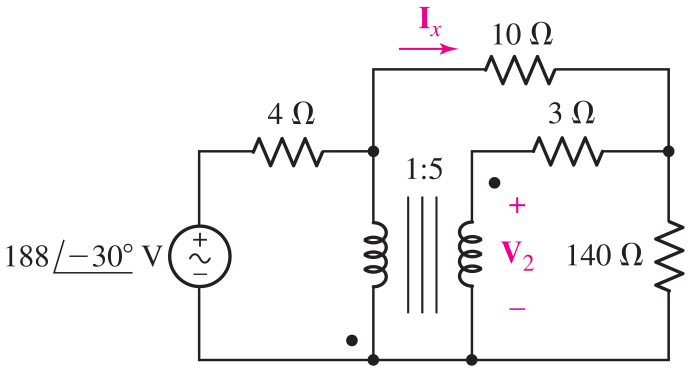

Figure 5: A simple circuit having an ideal transformer.

Question 5

With respect to the circuit depicted in Fig. 6,

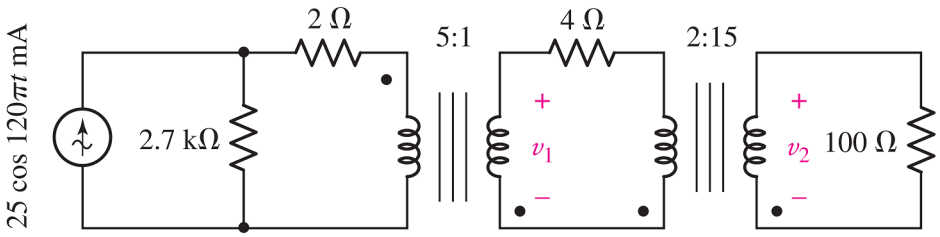

Figure 6: A circuit with two ideal transformers.

(a) Calculate the voltages v_1 and v_2.

(b) Compute the average power delivered to each resistor.

SOFTWARE QUESTIONS

Question 6 continued on next page...

Question 6

A real transformer is usually modeled as the circuit of Fig. 6, where L_p is the primary leakage inductance, R_p is the primary copper loss, R_c is the core losses due to eddy currents and hysteresis, L_m is the magnetization inductance, L_s is the secondary leakage inductance, and R_s is the secondary copper loss. Use CircuitLab, which is an online circuit simulation platform, to investigate the impact of L_p, R_p, R_c, L_m, L_s, and R_s on the transformer performance. You may plot the voltages of the primary and secondary versus time to investigate the impact of each item.

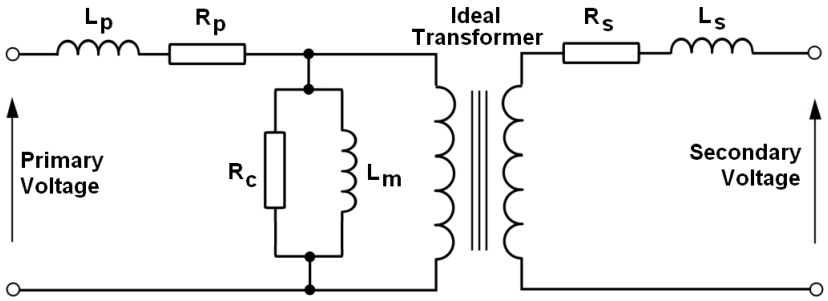

Figure 7: Real transformer equivalent circuits.

BONUS QUESTIONS

Question 7

Return your answers by filling the LaTeXtemplate of the assignment. If you want to add a circuit schematic, you can draw it directly using TikZ package, or draw it in a secondary application such as Microsoft Visio and then, import it as a figure.

EXTRA QUESTIONS

Question 8

Feel free to solve the following questions from the book *"Engineering Circuit Analysis"* by W. Hayt, J. Kemmerly, and S. Durbin.

Question 8 continued on next page...

1. **Chapter 13, question 5.**
2. **Chapter 13, question 18.**
3. **Chapter 13, question 21.**
4. **Chapter 13, question 22.**
5. **Chapter 13, question 44.**
6. **Chapter 13, question 48.**