MATHEMATICAL QUESTIONS

Question 1

Find the unidirectional Laplace transform of the following functions.

(a) $f(t) = 2|K|e^{-at}\cos(\beta t + \underline{/K})u(t)$.

(b) $f(t) = 2|K|te^{-at}\cos(\beta t + \underline{/K})u(t)$.

(c) $f(t) = g(t)u(t), \quad g(t) = at[u(t) - u(t-a)], g(t-a) = g(t)$.

(d) $f(t) = e^{-at^2}$.

Question 2

Find the inverse unidirectional Laplace transform of the following functions.

(a) $F(s) = a\frac{-as-1+e^{as}}{s^2(e^{as}-1)}$.

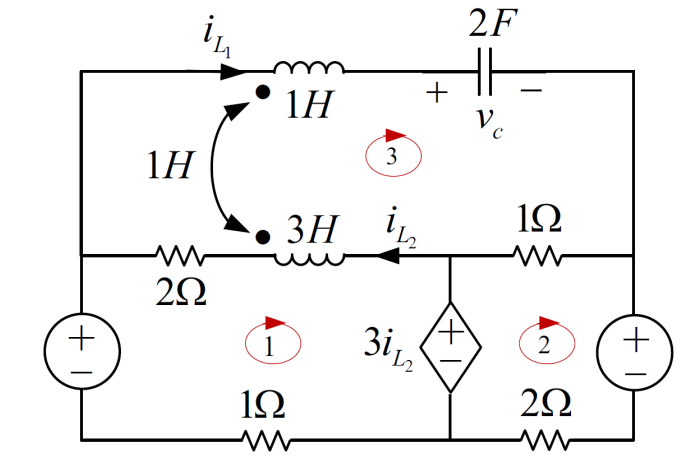
(b) $F(s) = \frac{1}{s(s+1)^2(s^2+1)^2}$.

(c) $F(s) = \frac{s}{(s^2+2s+2)^3}$.

Question 3

Calculate the time-domain mesh currents for the circuit of Fig. 1.

Question 3 continued on next page...



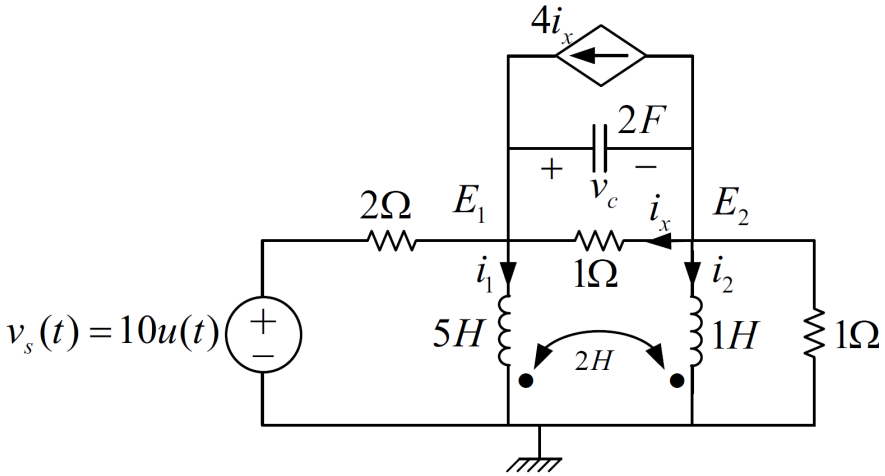
$$v_{s1}(t) = 5u(t) \qquad v_{s2}(t) = 2\cos tu(t)$$

$$v_c(0^-) = 2V,\ i_{L_1}(0^-) = 2A,\ i_{L_2}(0^-) = 3A$$

Figure 1: A coupled circuit for which the mesh currents are required.

Question 4

Obtain the time-domain node voltages for the circuit of Fig. 2.



$$v_c(0^-) = 2V,\ i_1(0^-) = 2A,\ i_2(0^-) = 3A$$

$$L = \begin{pmatrix} 5 & 2 \\ 2 & 1 \end{pmatrix} \Rightarrow \Gamma = L^{-1} = \begin{pmatrix} 1 & -2 \\ -2 & 5 \end{pmatrix}$$

Figure 2: A coupled circuit for which the node voltages are required.

Question 4 continued on next page...

Question 5

Find an expression for $v(t)$ valid for all times in the circuit of Fig. 3.

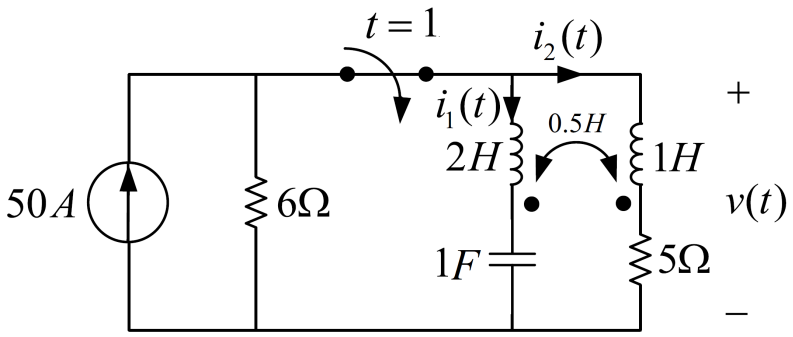


Figure 3: A circuit with a switch opened at $t = 1$.

SOFTWARE QUESTIONS

Question 6

Use AC analysis of PSpice to investigate the frequency response $H(j\omega) = \frac{V_o(j\omega)}{V_s(j\omega)}$ of the double-tuned circuit shown in Fig. 4. Analyze the impact of each parameter on the frequency response.

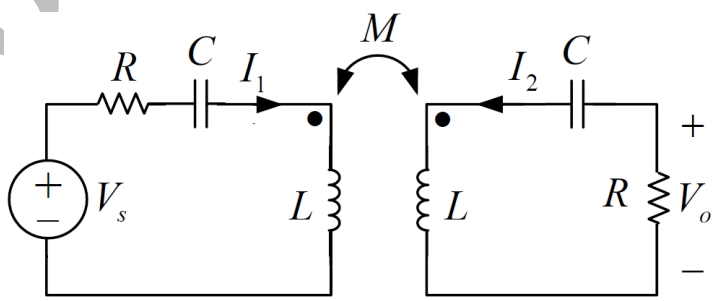


Figure 4: Double-tuned circuit.

Question 6 continued on next page...

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.

1. **Chapter 15, question 14.**
2. **Chapter 15, question 19.**
3. **Chapter 15, question 22.**
4. **Chapter 15, question 24.**
5. **Chapter 15, question 27.**