LUMS
A Not-for-Profit University

School of Science and Engineering

EE 240 Circuits-I

ASSIGNMENT 5

Due Date: 1 pm, Wednesday, December 11, 2024.
Format: 7 problems, for a total of 100 marks
Instructions:

- You are allowed to collaborate with your peers but copying your colleague's solution is strictly prohibited. This is not a group assignment. Each student must submit his/her own assignment.
- Solve the assignment on blank A4 sheets and staple them before submitting.
- Submit in-class or in the dropbox labeled EE-240 outside the instructor's office.
- **Write your name and roll no. on the first page.**
- Feel free to contact the instructor or the teaching assistants if you have any concerns.

- You represent the most competent individuals in the country, do not let plagiarism come in between your learning. In case any instance of plagiarism is detected, the disciplinary case will be dealt with according to the university's rules and regulations.
- We require you to acknowledge any use or contributions from generative AI tools. Include the following statement to acknowledge the use of AI where applicable.

  I have used [insert Tool Name] to [write, generate, plot or compute; explain specific use of generative AI] [number of times].

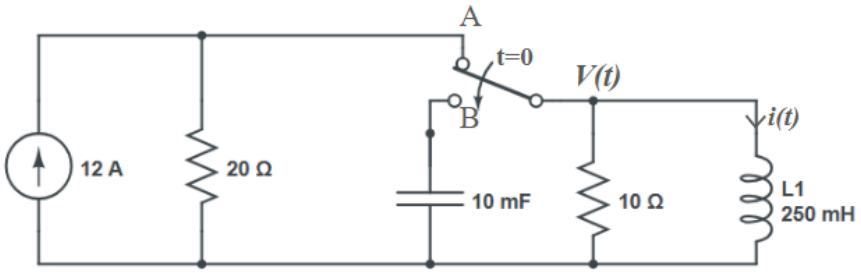
Problem 1 (10 marks)

In the circuit below, the switch has been in position A for a long time before moving from position A to B at $t = 0$. Determine:

(a) **[2 marks]** $i(t = 0^+)$ and $v(t = 0^+)$.

(b) **[4 marks]** $\frac{di}{dt}\Big|_{t=0^+}$ and $\frac{dv}{dt}\Big|_{t=0^+}$.

(c) **[4 marks]** $\frac{d^2i}{dt^2}\Big|_{t=0^+}$ and $\frac{d^2v}{dt^2}\Big|_{t=0^+}$.



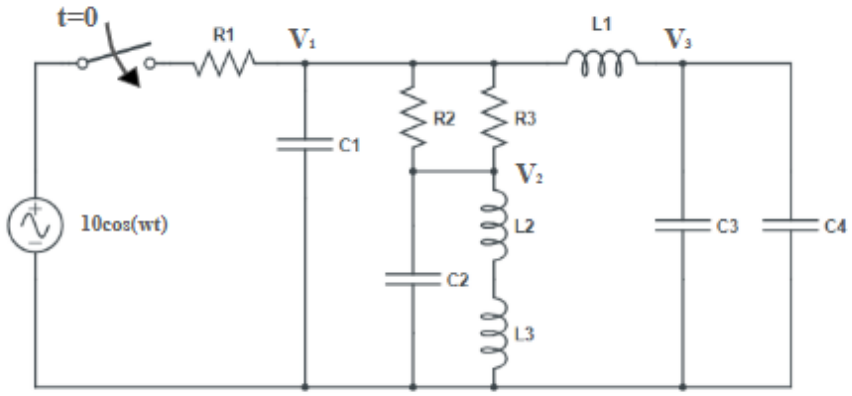
Problem 2 (10 marks)

In the following circuit, the switch is closed at t = 0. Determine:

(a) **[3 marks]** $V_1(t = 0^+)$ $V_2(t = 0^+)$and $V_3(t = 0^+)$.

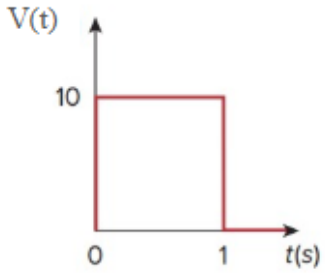
(b) **[4 marks]** $\frac{dV_1}{dt}\Big|_{t=0^+}$ and $\frac{dV_2}{dt}\Big|_{t=0^+}$.

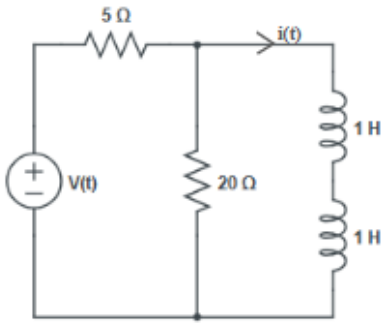
(c) **[3 marks]** $\frac{d^2V_1}{dt^2}\Big|_{t=0^+}$.



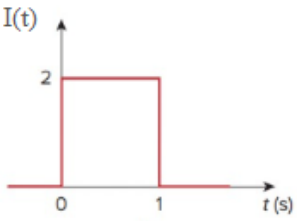
Problem 3 (10 marks)

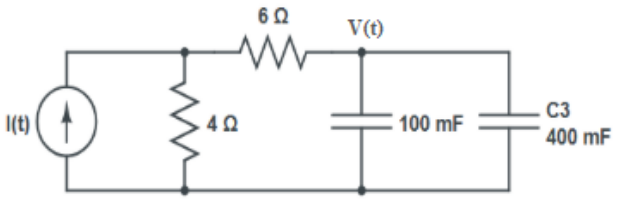
(a) **[5 marks]** The time varying input V(t) is applied to the circuit shown below. Determine the response $i(t)$.





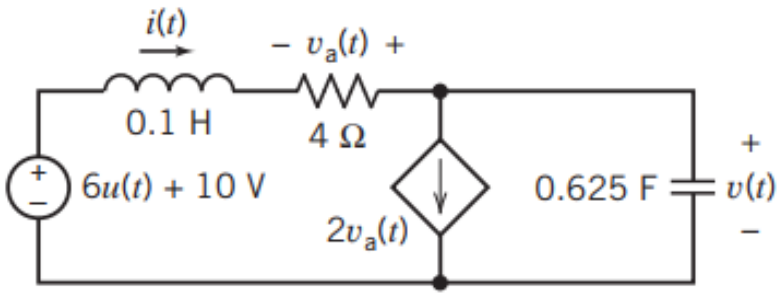
(b) **[5 marks]** The time varying input I(t) is applied to the circuit shown below. Determine the response $V(t)$.



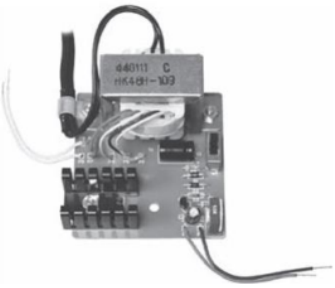


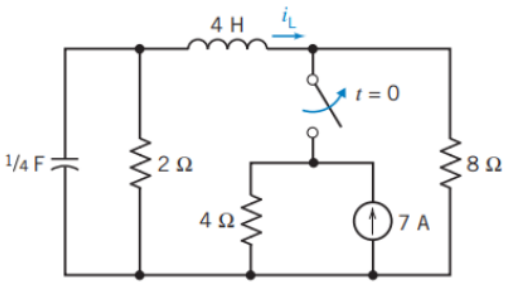
Problem 4 (20 marks)

(a) [**10 marks**] For the circuit shown below, determine $v(t)$ for $t > 0$.



(b) [**10 marks**] A 240 W power supply circuit is shown in figure (a). This circuit employs a large inductor and a large capacitor. The model of the circuit is shown in figure (b).
Find $i_L(t)$ for $t > 0$ for the circuit of figure (b). Assume steady-state conditions exist at $t = 0^-$.





Problem 5 (15 marks)

(a) [**10 marks**] The responses of a series RLC circuit are:

$$v_C(t) = 30 - 10e^{-20t} + 30e^{-10t}\,\text{V}$$

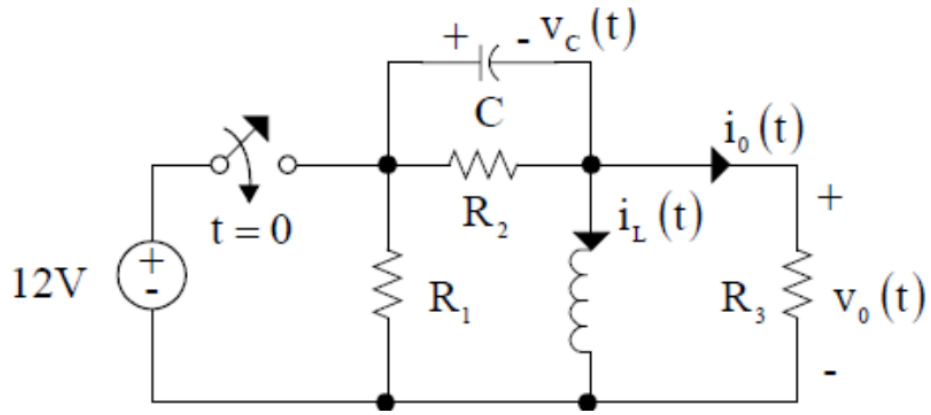
$$i_L(t) = 40e^{-20t} - 60e^{-10t}\,\text{mA}$$

where $v_C(t)$ and $i_L(t)$ are the capacitor voltage and inductor current, respectively. Determine the values of R, L, and C.

(b) [**5 marks**] A series RLC circuit contains a resistor R = 2 Ω and a capacitor C = 1/2 F. Select the value of the inductor so that the circuit is critically damped.

Problem 6 (15 marks)

Consider the circuit shown in the following figure. Find the current $i_0(t)$ for $t > 0$. Assume: $R_1 = R_2 = R_3 = 24\ \Omega$, L = 2.4 H, and C = 1/120 F.



Problem 7 (20 marks)

Find $v(t)$ for $t > 0$ in the circuit shown below.