EE240: Circuits I

ASSIGNMENT 4

Due Date: 04 Nov 2019

- Submissions will only be accepted on A4 sized papers.
- Write your name and roll number clearly at the top of the assignment.
- You are required to show working where necessary; answers will not be graded if working is not shown.
- The assignment is worth **100** marks, you are advised to start early as it is long.
- Feel free to contact the instructor or teaching assistants if you have any questions.
- Any instance of plagiarism will be **severely** dealt with; such cases would be subjected to **disciplinary action** in accordance with university rules and regulations.

In all of the following questions, assume that the circuit was in steady state before the switch is moved.

Problem 1 (10 marks)

For the figure shown below, calculate $v(0^-)$ and derive an expression for $v(t)$ for $t < 0$.

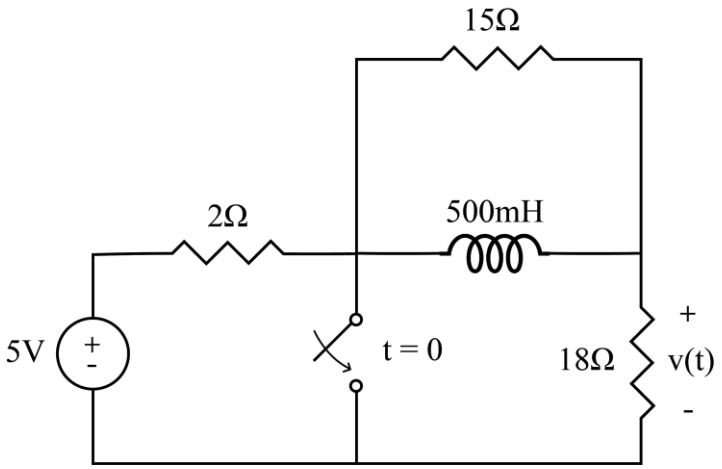

Figure 1

Problem 2 (20 marks)

(a) **[15 marks]** In the circuit shown in Fig. 2, the switch is closed at $t = 0$, determine $i(t)$ for **all time**.

(b) **[5 marks]** Sketch $i(t)$ for $t > 0$ on an appropriate scale.

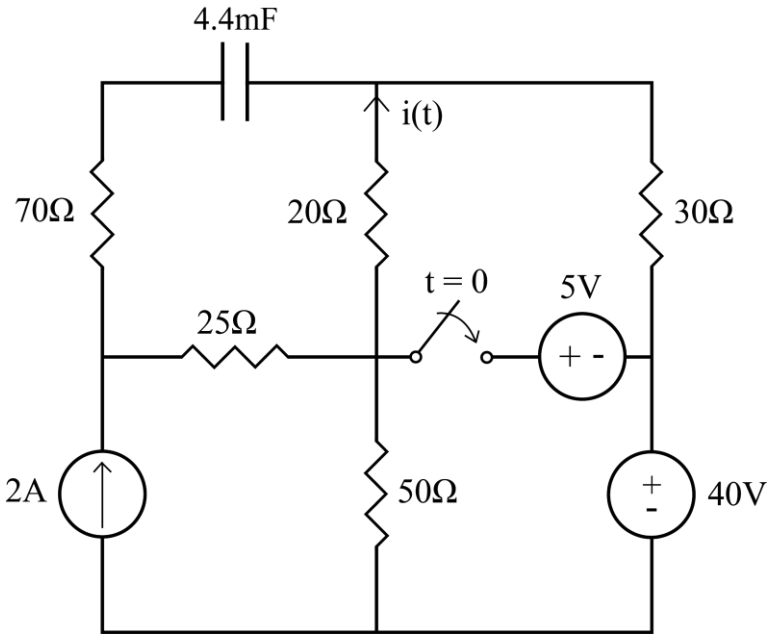

Figure 2

Problem 3 (15 marks)

For the circuit given below, determine $v(t)$ for $t > 0$ and sketch its waveform.

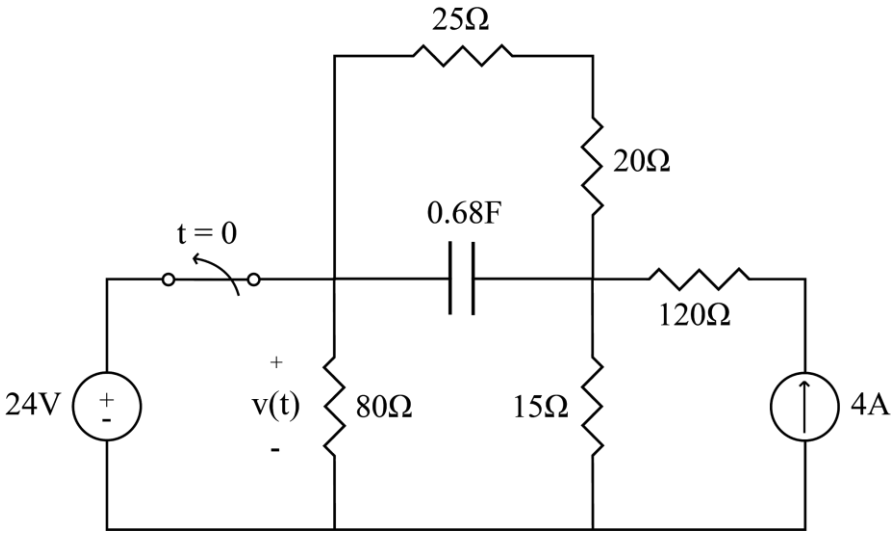

Figure 3

Problem 4 (10 marks)

For the circuit given below, calculate:

(a) i_0 and v_0 for times $t = 0^-$ and $t = 0^+$.

(b) dv_0/dt at $t = 0^+$.

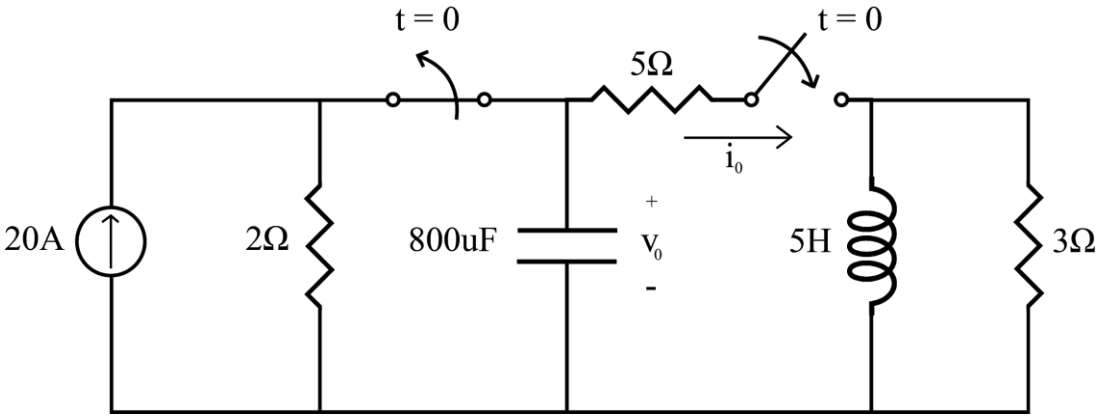

Figure 4

Problem 5 (15 marks)

In *figure 5* shown below, the switch is initially open and steady state is achieved. At time t=0, the switch is closed.

(a) **[4 marks]** Produce the first order differential equations that govern the circuit.

(b) **[2 marks]** Determine Vc (0^-), the voltage across the capacitor before the switch is closed. Indicate its polarity.

(c) **[8 marks]** Calculate $i_1(0^+)$, $i_2(0^+)$, $di_1(0^+)/dt$, and $di_2(0^+)/dt$.

(d) **[1 mark]** Determine $di_1(\infty)/dt$.

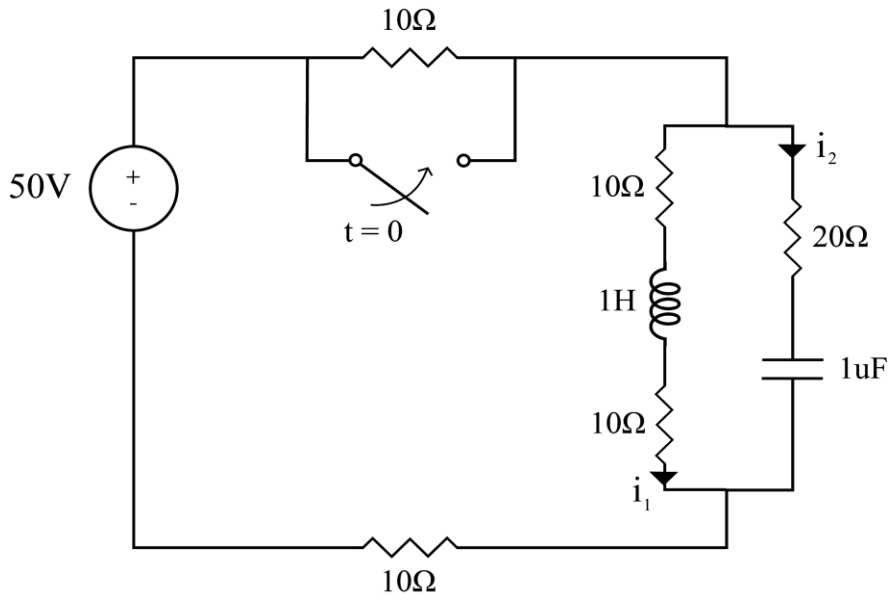

Figure 5

Problem 6 (15 marks)

For the circuit given below, calculate the following at time $t = 0^+$.

(a) **[5 marks]** di_1/dt

(b) **[5 marks]** di_2/dt

(c) **[5 marks]** d^2i_2/dt^2

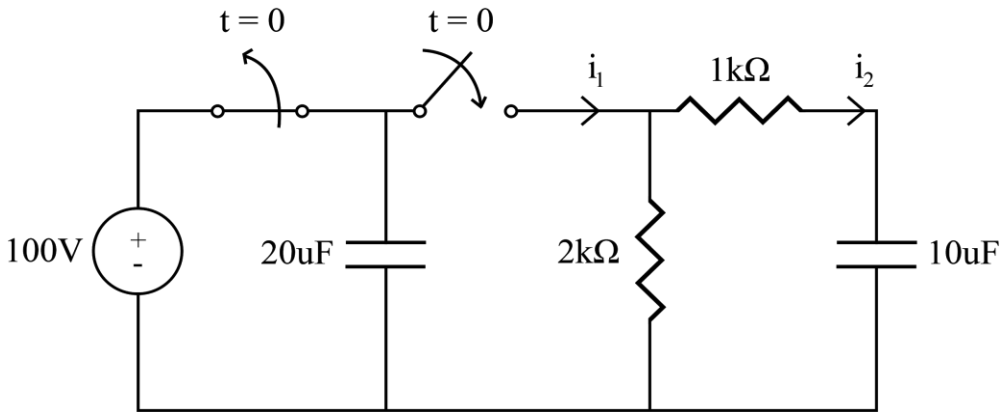

Figure 6

Problem 7 (15 marks)

In *figure 7* shown below, the switch is initially open and steady state is achieved. At time t = 0, the switch is closed.

(a) **[8 marks]** Derive the equation for the current through the inductor for t > 0.

(b) **[2 marks]** Sketch the current through the inductor for all time.

(c) **[5 marks]** Find the time constant.

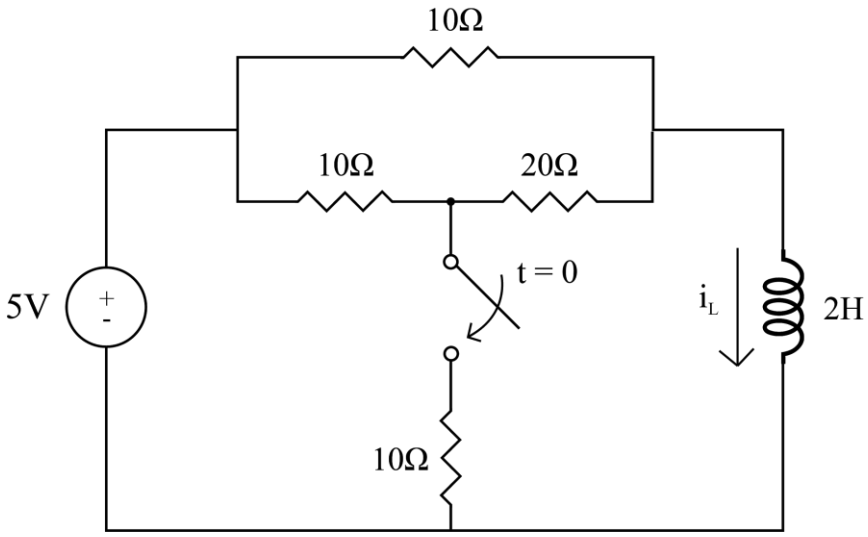

Figure 7