MATHEMATICAL QUESTIONS

Question 1

Find an expression for $v_c(t)$ in Fig. 1 valid for all time t.
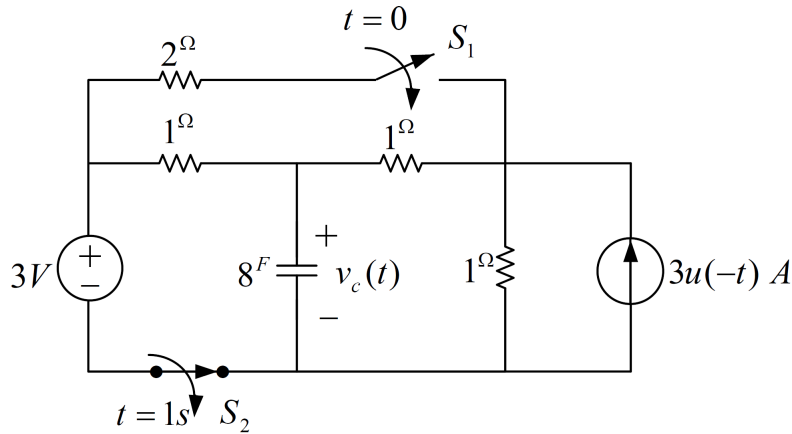

Figure 1: An RC circuit with two switches.

Question 2

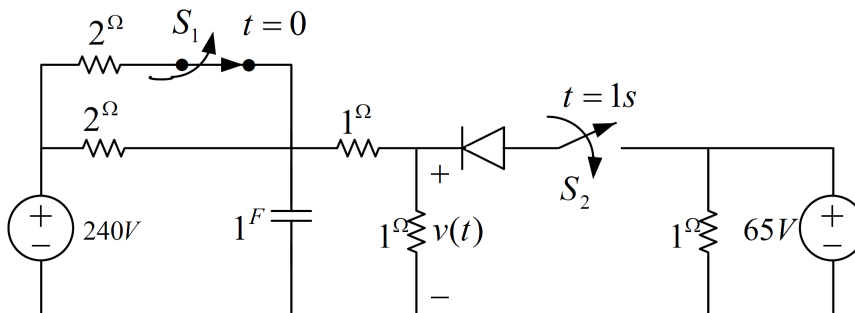**Find an expression for $v(t)$ in Fig. 2 valid for all time t.**

Figure 2: A nonlinear RC circuit with diode.

Question 3

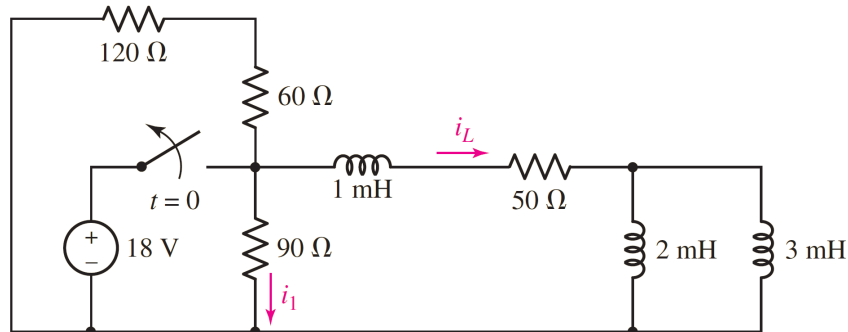**Determine both i_1 and i_L in the circuit shown in Fig. 3 for $t > 0$.**

Figure 3: A circuit with multiple resistors and inductors.

Question 4
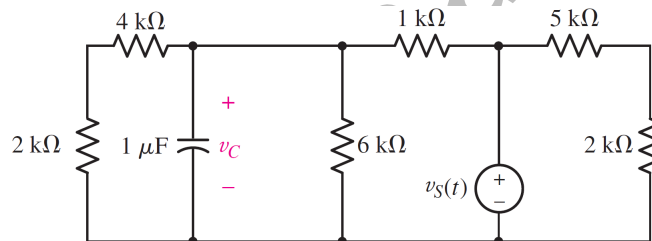
Consider the circuit shown in Fig. 4.

Figure 4: A first-order LIT RC circuit.

(a) Find the step response of $v_c(t)$.

(b) Find the impulse response of $v_c(t)$.

(c) Find the zero-state response of $v_c(t)$ if $v_s(t) = 5u(t) + 2\delta'(t)$.

(d) Find the zero-state response of $v_c(t)$ if $v_s(t) = 2e^{-2t}u(t)$.

(e) Find the zero-state response of $v_c(t)$ if $v_s(t) = 2\cos(t)u(t)$.

SOFTWARE QUESTIONS

Question 5

Consider the circuit shown in Fig. 5, where the diodes are 1N4148 and $v_s(t)$ is a periodic square signal with low level 0, high level 15 V, duty cycle 0.5, and period T. Simulate the circuit in PSpice and plot the capacitor voltage versus time when $\tau_1 = R_1C \ll T$ and $\tau_2 = R_2C \ll T$ and when $\tau_1 = R_1C \gg T$ and $\tau_2 = R_2C \gg T$. Discuss and compare the results.
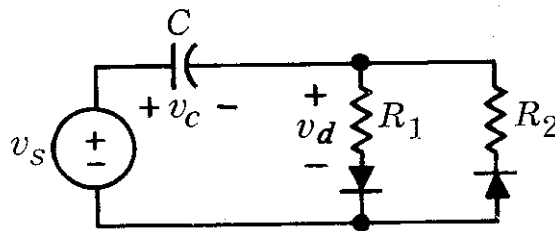

Figure 5: A first-order NTI RC circuit.

BONUS QUESTIONS

Question 6

Find an expression for the NTI resistor voltage in Fig. 6 valid for $t > 0$. Assume that $v_c(0^+) = V_0 = 3$.
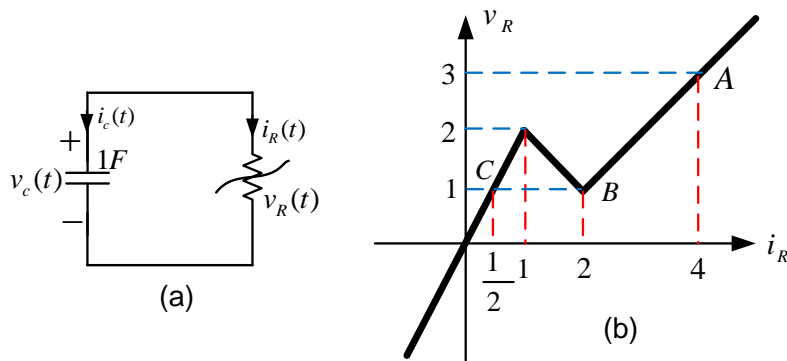
Figure 6: (a) A nonlinear RC circuit with an NTI resistor (b) Characteristic curve of the NTI resistor.

Question 7

Return your answers by filling the LATEXtemplate of the assignment.

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 8, question 29.**

2. **Chapter 8, question 31.**

3. **Chapter 8, question 37.**

4. **Chapter 8, question 38.**

5. **Chapter 8, question 39.**

6. **Chapter 8, question 48.**

7. **Chapter 8, question 50.**

8. **Chapter 8, question 51.**

9. **Chapter 8, question 52.**

10. **Chapter 8, question 58.**

11. **Chapter 8, question 60.**

12. **Chapter 8, question 61.**

13. **Chapter 8, question 64.**