LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
Department of Electrical Engineering

EE240 Circuits I
Quiz 08 - Section 1 (Solutions)

Name: ______________________

Campus ID: ______________________

Total Marks: 10
Time Duration: 20 minutes

Question 1 (10 marks)

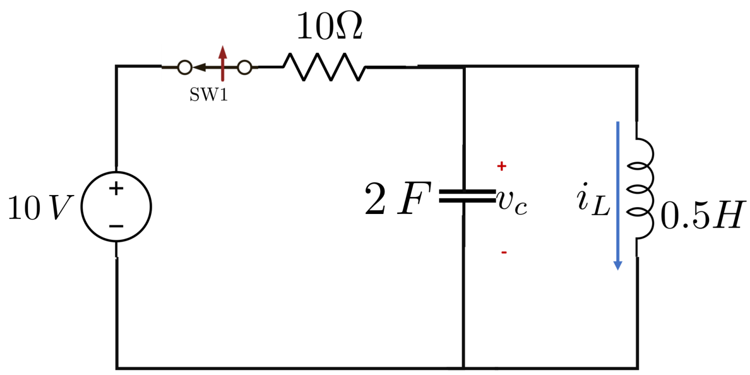
In the following circuit, the switch is *opened* at $t = 0$.

(a) [5 marks] Determine the current $i_L(t)$ for all times.

(b) [2 marks] Determine the voltage $v_c(t)$ for all times

(c) [2 marks] Plot the current $i_L(t)$.

(d) [1 mark] What is the nature (over-damped, under-damped, critically damped or undamped) of the response?



Solution:

(a) **Initial Conditions:**
- Inductor short-circuited, which implies: $i_L(0^-) = 1\,A, \quad v_c(0^-) = 0$.
- Voltage across inductor is $L di_L/dt$.
- $i_L(0^+) = 1\,A$, $\frac{di_L(0+)}{dt} = 0$ (Since voltage across capacitor is zero at $t = 0^+$).

Network Equation for $t \geq 0$
Using KCL, we have

$$LC\frac{d^2 i_L}{dt^2} + i_L = \frac{d^2 i_L}{dt^2} + i_L = 0.$$

The roots of the characteristic equation $s^2 + 1$ are $s_1, s_2 = \pm j$. Therefore the solution is

$$i_L(t) = K_1 \cos(t) + K_2 \sin(t) = \cos(t).$$

Since we have $K_1 = 1$ and $K_2 = 0$ using initial conditions.

(b)

$$v_c(t) = L\frac{di_L}{dt} = 0.5\frac{di_L}{dt} = -\sin(t).$$

(d) Undamped