LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
Department of Electrical Engineering

EE240 Circuits I
Quiz 05 - Section 1 (Solutions)

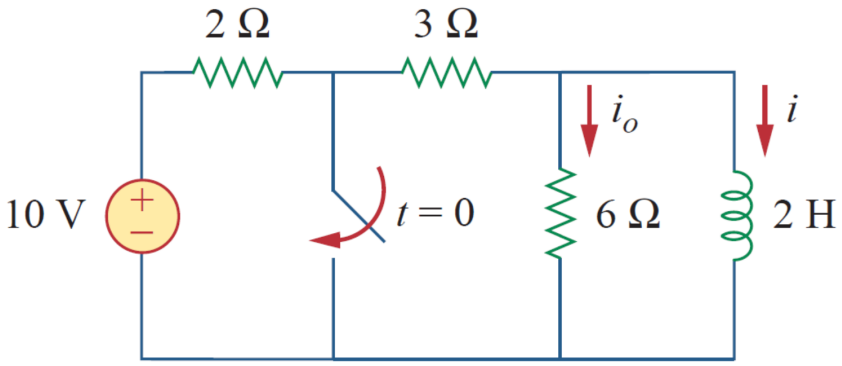
Name: _____

Campus ID: _____

Total Marks: 10
Time Duration: 20 minutes

Question 1 (10 marks)

In the following circuit, the switch is closed at $t = 0$. Determine the currents $i(t)$ and $i_o(t)$ for all times. Also plot the currents for $-\tau \leq t \leq 6\tau$ (where τ denotes the time constant of the circuit).



Solution:

At $t = 0^-$:
- Inductor is short-circuit
- $i_o(0^-) = 0\ A$
- $i(0^-) = \frac{10}{5} = 2\ A$

At $t = 0^+$:
- Switch is closed, implies that the source is removed
- $i(0^+) = i(0^-) = 2\ A$; inductor acts as a current source of $2\ A$
- $i_o(0^+) = -\frac{3}{9} \times 2 = 2/3\ A$

At $t = \infty$:
- No source
- $i_o(\infty) = i(\infty) = 0\ A$

Time constant τ:
- Resistance across inductor, $R_{\text{eq}} = 6||3 = 2\,\Omega$
- $\tau = L/R_{\text{eq}} = 1\ s$

Solution Formulation:

$$i(t) = \begin{cases} 2 & t < 0 \\ 2\,e^{-t} & t \geq 0 \end{cases}$$

$$i_o(t) = \begin{cases} 0 & t < 0 \\ -\frac{2}{3}\,e^{-t} & t > 0 \end{cases}$$