

LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
Department of Electrical Engineering

EE240 Circuits I – Quiz 06

Total Marks: 10

Time Duration: 30 minutes

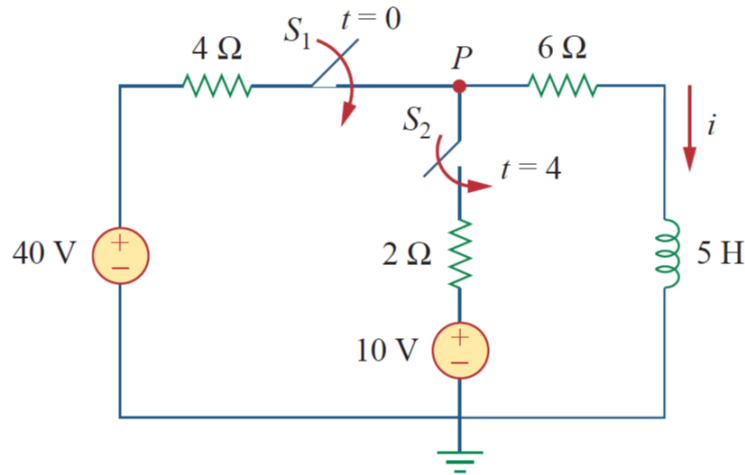
Instructions:

- *Pretty logical and natural, I believe!* We require you to solve the quiz in a single time-slot of 30 minutes without *any* external assistance.
- You should not discuss the quiz with your peers.
- You must solve the problem on A4 paper.
- If you are ready, please proceed to the next page.

خودی کی ہوت ہو جس میں سروری کیا ہے!

Question 1 (10 marks)

In the network given below, the switches are opened for long time. Switch S_1 is closed at $t = 0$ and Switch S_2 is closed at $t = 4$ s. Determine $i(t)$ for all times. Also plot $i(t)$ for $-1 \leq t \leq 7$ s.



Solutions:

Initial Conditions:

$$i(0^-) = i(0^+) = 0.$$

S1 is closed; time $0 \leq t < 4$:

Assuming that S1 remains closed forever and S2 does not exist, we have

$$i(\infty) = 4 \text{ A}, \quad R_{\text{eq}} = 4 + 6 = 10 \Omega, \quad \tau = \frac{L}{R_{\text{eq}}} = \frac{1}{2} \text{ s}$$

$$i(t) = 4(1 - e^{-2t}), \quad 0 \leq t < 4 \tag{1}$$

S2 is closed; time $4 \leq t < \infty$:

Now the initial conditions should be evaluated at $t = 4^-$. Using eq (1), $i(4) = 3.9987 \approx 4 \text{ A}$ (assuming exponential decays in approximately 5 time-constants).

$$i(\infty) = \frac{30}{11} = 2.727, \quad R_{\text{eq}} = 4 \parallel 2 + 6 = \frac{22}{3} \Omega, \quad \tau = \frac{L}{R_{\text{eq}}} = \frac{15}{22} \text{ s}.$$

$$i(t) = 2.727 + 1.273e^{-22(t-4)/15}, \quad 4 \leq t \tag{2}$$

