LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
Department of Electrical Engineering

EE240 Circuits I
Quiz 02 - Section 2 - Solutions

Name: _____

Campus ID: _____

Total Marks: 10
Time Duration: 15 minutes

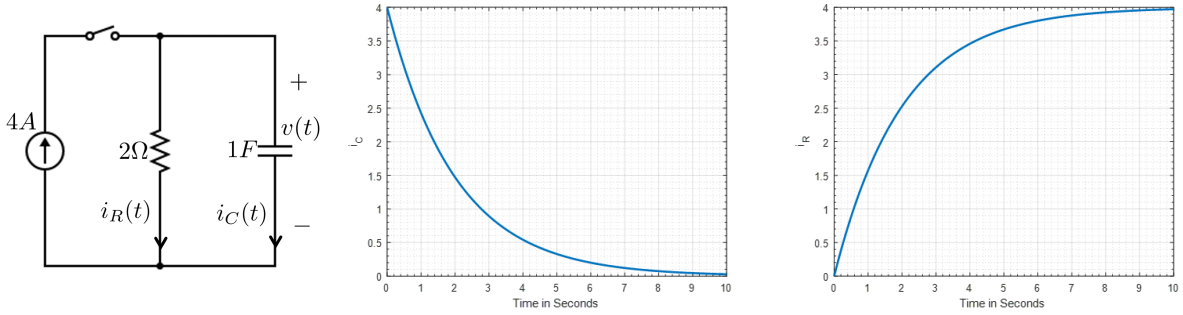
Question 1 (5 marks)

Consider a circuit where the DC current source of $4A$ is connected with a parallel combination of a 2 Ω resistor and $1F$ capacitor through the switch. Assume that the switch is initially open and is closed at $t = 0$ and the capacitor is not carrying any charge before the switch is closed, that is, the voltage across capacitor $v(t) = 0$ for all $t < 0$.

(a) [1 mark] Draw the circuit and indicate the voltage $v(t)$ across the capacitor and the currents $i_R(t)$ and $i_C(t)$ through the resistor and capacitor respectively.

(b) [4 marks] Plot the waveforms of the currents $i_R(t)$ and $i_C(t)$.

Solution: Circuit and waveforms:



Question 2 (3 marks)

The current through the $0.5H$ inductor is given by

$$i(t) = \begin{cases} 1 - e^{-2t}, & t \geq 0, \\ 0, & t < 0. \end{cases}$$

Determine the total energy consumed by the inductor.

Solution: Voltage $v(t)$ across the inductor is given by

$$v(t) = L\frac{d}{dt}i(t) = e^{-2t}, \quad t \geq 0$$

Power and energy are given by

$$p(t) = v(t)\, i(t) = e^{-2t} - e^{-4t}, \quad t \geq 0$$

$$W = \int_0^\infty p(t)dt = \frac{1}{4}\text{J}$$

Alternatively

$$w(t) = \frac{1}{2}L\, i^2(t) = \frac{1}{4}(1 + e^{-4t} - e^{-2t}), \quad t \geq 0. \quad W = w(\infty) = \frac{1}{4}\text{J}$$

Question 3 (2 marks)

Do you agree with the following statements (support your answer with the justification)?

(a) [1 mark] Ideal voltage sources can be connected in series.

Solution: Yes! The voltage sources connected in series can be replaced with an equivalent voltage sources of voltage as sum of the voltages of the connected sources in series.

(b) [1 mark] Ideal voltage source and ideal current source in series is equivalent to the voltage source only.

Solution: No! Ideal voltage source and ideal current source in series is equivalent to the current source only.