LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
Department of Electrical Engineering

EE 240 Circuits I
Quiz 7

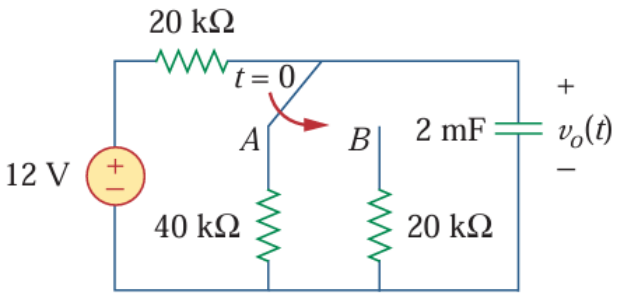
Name: _____

Campus ID: _____

Total Marks: 10
Time Duration: 15 minutes

Question 1 (10 marks)

Assuming that the switch in the circuit given below has been in position A for a long time and is moved to position B at $t = 0$. Find $v_o(t)$ at $t \geq 0$



Solution:
When the switch has been at position A for a long time, the circuit reaches steady state. The voltage across the capacitor should be the same as the voltage across the $40k\Omega$ resistor which is:

$v_o(0^-) = \frac{40}{40+20}(12\,\text{V}) = 8\,\text{V}$
$v_o(0^-) = v_o(0^+) = 8\text{V}$

When the switch has been at position B for a long time, the circuit reaches steady state again. Now, the voltage across the capacitor should be the same as the voltage across the $20k\Omega$ resistor in parallel with the capacitor which is:

$v_o(\infty) = \frac{20}{20+20}(12\,\text{V}) = 6\,\text{V}$

To find an expression for $v_o(t)$ we need k_1, k_2 and τ which we can find in the following way:

$k_1 = v_o(\infty) = 6\text{V}$

$k_2 = v_o(0^+) - v_o(\infty) = 8 - 6 = 2\text{V}$

Find R_{eq} across the capacitor terminals by shorting the voltage source. You will be left with the two $20k\Omega$ resistors in parallel.

$R_{eq} = 20||20 = 10k\Omega$

$\tau = R_{eq}C = 10k * 2m = 20s$

Putting it all together:

$v_o(t) = k_1 + k_2 e^{-t/\tau}$

$v_o(t) = 6 + 2e^{-t/20}\text{V}$