EE 61 Section 2, Spring 2001  
Test III  
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Name (please print) ________________________________________________________________

In keeping with the Honor Code, I have neither provided nor received any assistance on this test. I understand if it is later determined that I gave or received assistance, I will fail the class and will be brought before the Undergraduate Judicial Board.

Signature: ________________________________________________________________

Problem I: [21 pts.] Initial and Final Conditions

Given the switched circuit on the following page and the known values $v_a$, $i_b$, $R_1$, $R_2$, $R_3$, $R_4$, $L$, and $C$, solve for the values listed below. Assume that $v_a$ and $i_b$ are constants and that the switch has been closed for a very long time before $t = 0$ s.

(1) $i_L(0^-)$

(2) $v_C(0^-)$

(3) $i_x(0^-)$

(4) $v_L(0^+)$

(5) $i_x(0^+)$

(6) $i_L(\infty)$

(7) $v_C(\infty)$
Problem II: [15 pts.] Switched Circuits

Given the following switched circuit:

![Switched Circuit Diagram]

Solve for the capacitor voltage $v_c(t)$ for $t > 0$ s given:

- $v_a(t) = 3$ V
- $v_b(t) = 4 \cos(10t)$ V
- $R_1 = 10$ Ω
- $R_2 = 5$ kΩ
- $C = 60$ μF

Assume that the left switch has been closed and the right switch has been open for a very long time before $t = 0$ s.
Problem III: [15 pts.] Second-Order Circuits

Given the following circuit:

and known values \( R_1, R_2, R_3, R_4, L_1, \) and \( C_2 \), find a single second-order differential equation relating the output voltage \( v_o \) to the input voltage \( v_i \). You may use frequency notation to solve this problem though that is certainly not required (and you must express your answer in time notation). Hint: the best extra unknown to create is the current through the inductor.
Problem IV: [9 pts.] Complex Numbers

Given:

\[ A = -3 + j4 \]
\[ B = 10 \angle 30^\circ \]
\[ C = 9e^{-j3\pi/4} \]

find

(1) \( \frac{\|A\|B}{\|C\|} \) in polar notation

(2) \( \frac{\sqrt{C^2 + C}}{A} \) in Cartesian notation

(3) \( \frac{ABC}{|ABC|} \) in Euler notation
Problem V: [10 pts.] Frequency Equivalent Circuit

Redraw the circuit below in the frequency domain. Be sure every element, source, and auxiliary variable gets translated.
Problem VI: [20 pts.] Thévenin Equivalent Circuit

Given the circuit below:

Find and draw the Thévenin equivalent circuit in terms of the known values $i_a$, $R_1$, $R_2$, $R_3$, and $r$. Assume the source is constant. Note that $i_x$ is not known.
Problem VII: [10 pts.] Differential Equation

Given the following differential equation:

\[ 10m + 20 \frac{dm}{dt} = 40 \]

and the initial condition \( m(0) = 7 \), find and sketch the value of \( m(t) \) for \( t > 0 \) s.