Exam #2
ECE 320: Fundamentals of Electrical Engineering
Fall 2011

All Students:

- Exam is 50 minutes.
- Exam is closed book and notes.
- Answer questions as the directions state.
- You must show your work to receive full credit.
- Provide answers in the boxes provided.
- Be sure to include units on your answers as appropriate.
- No materials or calculators may be shared.
- No cell phone may be visible for any reason.
- Work only on the provided pages.
[1] (25 points)

Use Thevenin's Theorem to solve the circuit below. Find and draw the Thevenin's equivalent circuit for the load resistance $R_L$. Also, find the resistance $R_L$ that will provide maximum power transfer and the power absorbed by $R_L$.

\[ V = IR \]

\[ V = 2A \times 20 \Omega = 40V \]

\[ V_{th} = V - 30V = 10V \]

\[ V_{th} = 10V \]

\[ R_{eq} = 15 \Omega = R_L \]

\[ P_L = \left(\frac{V_{th}}{2}\right)^2 \frac{5}{3} \text{ W} \]

\[
\begin{array}{|c|c|}
\hline
V_{TH} & 10V \\
R_{EQ} & 15\Omega \\
R_L & 15\Omega \\
P_{RL} & \frac{5}{3} \text{ W} \\
\hline
\end{array}
\]
[2] (35 points)

Solve the circuit below. Find the $V_0(t)$ for $t > 0$. Use the six step method shown in class.
(Hint: The circuit is easier than it looks. Redraw the circuit for every step.)

1. $V_v(t) = k_1 + k_2 e^{-t/5}$

2. $V_c(0^-) = V_{v0}$

KVL $I_1$:

$-6V + 12V + V_A = 0$

KVL $I_2$:

$-6V + 12V + 4k_1 I_1 + 4k_2 I_2 = 0$

$V_A + V_c + V_B + 12V = 0$

$4k_1 I_1 + 4k_2 I_2 + 12V = 0$

$I_1 = -6/5$ A  $I_2 = -3/10$ A

$V_c(0^-) = 12k_2 (I_2) = -18/5$ (approx. b/c of terminals

$V_c(0^-) = 18/5V - 18/5V$  $-18V + 18/5V + V_A + V_B = 0$

3. $V_0(0^+)$

$V_0(t) = 4 + \frac{8}{5} e^{-\frac{5t}{10}} V$

$V_{c0} = \frac{18/5}{V}$

$V_{v0} = 5\sqrt{5}$ V

$V_{o(+)} = 4 \sqrt{5}$

$R_{EQ} = 6 k\Omega$

$\tau = 5 \text{ sec.}$

$K_1 = 4 V$

$K_2 = 3\sqrt{5} V$

$V_0(t) = 4 + \frac{8}{5} e^{-\frac{5t}{10}} V$
[3] (40 points)

Use phasors and nodal analysis to solve for the circuit below. Use the currents provided when setting up KCLs.

\[ I_1 = \frac{16 \angle 0 \, V - \mathcal{V}_A}{3 + 1 \angle 90 \, \Omega} \]

\[ I_2 = \frac{\mathcal{V}_A}{-2 \angle 90 \, \Omega} \]

\[ I_3 = 5.5 \angle 104 \, A \]

\[ I_4 = 2.25 \angle -13.2 \, A \]

\[ I_5 = 5.01 \angle 116 \, A \]

\[ I_1 = 1.88 \angle -45.0 \, A \]

\[ V_1 = (3 + j)(I_1) = 5.95 \angle 26.6 \, V \]

\[ V_2 = (2j)(I_2) = 11 \angle 14 \, V \]

\[ V_3 = (4 \angle 90 \, V)(I_3) = 9 \angle 76.8 \, V \]

\[ V_4 = (1 \angle 0)(I_4) = 5.01 \angle 116 \, V \]

\[ \mathcal{V}_A = 11.0 \angle 14.0 \, V \]

\[ V_B = 8.99 \angle 96.8 \, V \]

\[ V_C = 5.95 \angle -26.6 \, V \]

\[ V_2 = 11 \angle 19 \, V \]

\[ V_3 = 9 \angle 76.8 \, V \]

\[ V_4 = 5.01 \angle 116 \, V \]