Instructions

1. DO NOT START UNTIL TOLD TO DO SO.
2. Write your Name, division, professor, and student ID# (PUID) on your scantron sheet.
3. This is a CLOSED BOOKS and CLOSED NOTES exam.
4. There is only one correct answer to each question.
5. Calculators are allowed (but not necessary).
6. If extra paper is needed, use back of test pages.
7. Cheating will not be tolerated. Cheating in this exam will result in an F in the course.
8. If you cannot solve a question, be sure to look at the other ones and come back to it if time permits.
9. As described in the course syllabus, we must certify that every student who receives a passing grade in this course has satisfied each of the course outcomes. On this exam, you have the opportunity to satisfy outcomes i, iii, iv, and viii. (See the course syllabus for a complete description of each outcome.) On the chart below, we list the criteria we use for determining whether you have satisfied these course outcomes. Outcome i is a repeat. We use this outcome result only if you did not satisfy it previously.

<table>
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<tr>
<th>Course Outcome</th>
<th>Exam Questions</th>
<th>Total Points Possible</th>
<th>Minimum Points required to satisfy course outcome</th>
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<tr>
<td>i</td>
<td>6-9</td>
<td>28</td>
<td>14</td>
</tr>
<tr>
<td>iii</td>
<td>1-4</td>
<td>28</td>
<td>14</td>
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<td>iv</td>
<td>9-14</td>
<td>42</td>
<td>21</td>
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<tr>
<td>viii</td>
<td>5</td>
<td>7</td>
<td>7</td>
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</table>

If you fail to satisfy any of the course outcomes, don’t panic. There will be more opportunities for you to do so.

Potentially useful formulas are:

\[ x(t) = x(\infty) + \left[ x(t^*) - x(\infty) \right] e^{-\frac{t-t^*}{\tau}} \]
\[ \tau = \frac{L}{R} \]
\[ \tau = RC \]
\[ \omega_0 = \frac{1}{\sqrt{LC}} \]
1. Suppose that two experiments are performed on the circuit to the right and the results are tabulated below.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>$V_s$</th>
<th>$I_s$</th>
<th>$I_{out}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 V</td>
<td>3 A</td>
<td>14 A</td>
</tr>
<tr>
<td>2</td>
<td>1 V</td>
<td>-1 A</td>
<td>2 A</td>
</tr>
</tbody>
</table>

Then in the third experiment, if we choose $V_s=3$ V and $I_s=1$ A, the output $I_{out}$ (in A) will be

(1) 2  (2) 4  (3) 6  (4) 8  (5) 10  (6) 12  (7) 14

2. The current $I$ in the circuit to the right is

(1) 1 A  (2) 2 A  (3) 3 A  (4) 4 A  (5) 5 A  (6) 6 A  (7) -5 A
3. Find the Thevenin equivalent resistance $R_{TH}$ for the network below.

![Network Diagram]

(1) 1 Ω  (2) 1.6 Ω  (3) 2 Ω
(4) 2.5 Ω  (5) 3 Ω  (6) 5.5 Ω
(7) 7 Ω  (8) 8 Ω  (9) 9 Ω

4. For the following network, determine the short-circuit current (i.e. the current $i_A$ under short circuit condition) at the terminals A-B.

![Network Diagram]

(1) 90 mA  (2) 60 mA  (3) 40 mA
(4) 20 mA  (5) 0 mA  (6) -20 mA
(7) -40 mA  (8) 60 mA  (9) -90 mA
5. Find the maximum possible power transferred to the load resistor, $R_L$. 

![Circuit Diagram]

\[ P = \frac{V^2}{4R} \]

(1) 6 W (2) 9 W (3) 18 W (4) 36 W (5) 72 W (6) 144 W
6. The voltage $v_L(t)$ across an inductor ($L = 4\text{mH}$) is shown in the plot below. The current at $t = 0$ is 0. Which plot best represents the current $i_L(t)$ through the inductor?

![Image of plots](image-url)
7. In the circuit shown, the voltage source is \( v_s(t) = 4 \cos(t) \) V. Then \( v_L(t) \) is

(1) \(-3 \cos(t)\) V  
(2) \(3 \cos(t)\) V  
(3) \(-6 \sin(t)\) V  
(4) \(-6 \cos(t)\) V  
(5) \(-4 \sin(t)\) V  
(6) \(4 \sin(t)\) V  
(7) \(12 \sin(t)\) V

8. Find the equivalent inductance of the network shown.

(1) 1 H  
(2) 2 H  
(3) 3 H  
(4) 4 H  
(5) 8 H  
(6) 12 H  
(7) 16 H  
(8) 24 H
9. Find the time constant $\tau$, in seconds for $V_{out}(t)$.

(1) 1 sec  (2) 2 sec  (3) 3 sec  
(4) 4 sec  (5) 5 sec  (6) 6 sec  
(7) 7 sec  (8) 8 sec  

10. The following circuit consists of a switch and a step current source given by $2u(-t-1)$ A. Determine the current $i_L(t)$ (in A), for $t > -1$ second.

(1) $2e^{-2(t+1)}u(t+1)$  
(2) $2e^{2(t-1)}u(-t-1)$  
(3) $4e^{3(t+1)}u(-t-1)$  
(4) $\frac{1}{2}e^{-4(t-1)}u(t-1)$  
(5) $8e^{3(t+1)}u(-t-1)$  
(6) $4e^{4(t-1)}u(t+1)$  
(7) $2e^{-2(t+1)}u(-t+1)$  
(8) $\frac{3}{4}e^{\frac{1}{2}(t-1)}u(-t-1)$
11. For the circuit shown, the switch, which has been closed for a long time, opens at $t = 0$. Which expression yields the voltage $v(t)$ valid for $t > 0$?

\[
\begin{align*}
10V & + \\
\text{(1)} \quad 5V e^{-5000t} & \quad (2) \quad -5V e^{-5000t} \\
(3) \quad 5V \left(1 - e^{-5000t}\right) & \quad (4) \quad -5V \left(1 - e^{-5000t}\right) \\
(5) \quad 10V e^{-5000t} & \quad (6) \quad -10V e^{-5000t} \\
(7) \quad 10V \left(1 - e^{-5000t}\right) & \quad (8) \quad -10V \left(1 - e^{-5000t}\right)
\end{align*}
\]

12. For the following network, determine $i_{50}^\left(0^+\right)$.

\[
\begin{align*}
\begin{align*}
6V u(t) & + \\
(1) \quad 138.6 \text{ mA} & \quad (2) \quad 100 \text{ mA} \\
(3) \quad 120 \text{ mA} & \quad (4) \quad 37.5 \text{ mA} \\
(5) \quad 54.5 \text{ mA} & \quad (6) \quad 200 \text{ mA}
\end{align*}
\end{align*}
\]
13. In a first-order RC circuit excited by a voltage source, the capacitor voltage is represented as

\[ v_c(t) = 4 + 6e^{-t/2} \]

Find the time (in s) required for the capacitor voltage to change from 8 V to 5 V.
(Hint: Recall that \( \ln a - \ln b = \ln \frac{a}{b} \).)

(1) 2 \( \ln(3/6) \)
(2) 2 \( \ln(4) \)
(3) 4 \( \ln(4) \)
(4) 6 \( \ln(13/4) \)
(5) 2 \( \ln(8/5) \)

14. The switch changes from position “1” to “2” at time \( t = 0 \). The angular frequency, \( \omega \), for \( v_c(t) \) for \( t > 0 \) is:

(1) \( \frac{1}{16} \) rad/s  (2) \( \frac{1}{8} \) rad/s  (3) \( \frac{1}{4} \) rad/s
(4) \( \frac{1}{2} \) rad/s  (5) 1 rad/s  (6) 2 rad/s
(7) 4 rad/s  (8) 8 rad/s  (9) 16 rad/s