EXAM II **NAME:**
SPRING 2004 **SECTION 1 2 3**

March 4, 2004 (Circle your Section Number)

7 – 9 PM (DCC-318)

There are five problems in this Exam

All are equally weighted

1.
2.
3.
4.
5.
TOTAL

Please add your Name and Section to each page

Please show all your work clearly

One 8 ½ x 11 inch Crib Sheet is allowed

Laplace Tables are attached to this Exam

EXAM II **NAME:**
SPRING 2004 **SECTION 1 2 3**

Problem 1.

a) [7 points]: For the circuit in figure 1(a), determine the equivalent capacitance seen by the voltage source and compute the current supplied by the source.

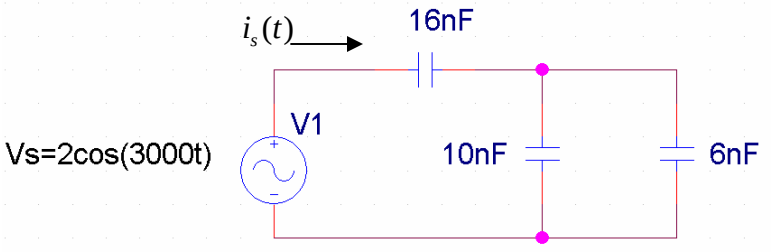


Figure 1 (a)

$C_{eq} =$ _____ $i_s(t) =$ _____

b) [7 points]: The voltage across an inductor $L = \frac{1}{2} H$ is given in figure 1(b). Sketch the current through the inductor for $0 \le t \le 6\,\text{sec}$. Assume $i_L(0) = 0$. Clearly specify the value of the current at salient points on the graph.

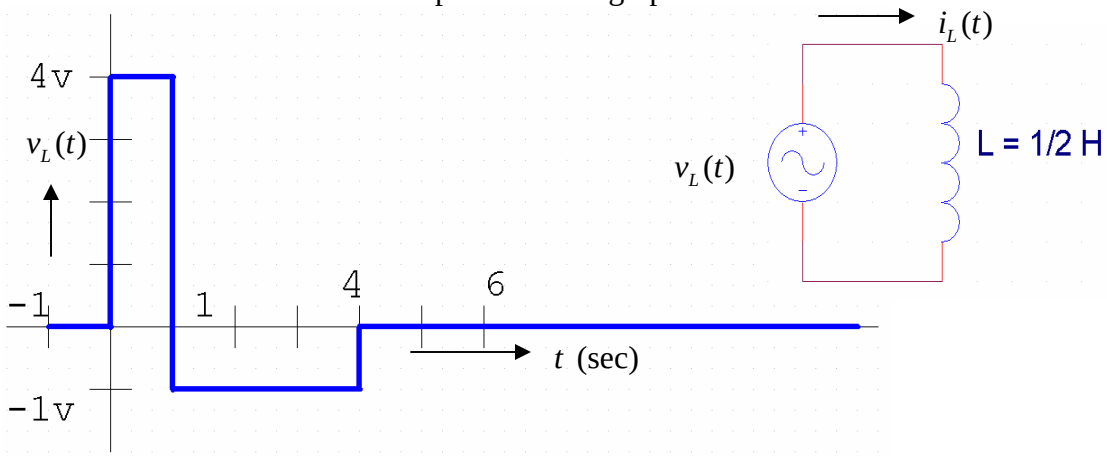
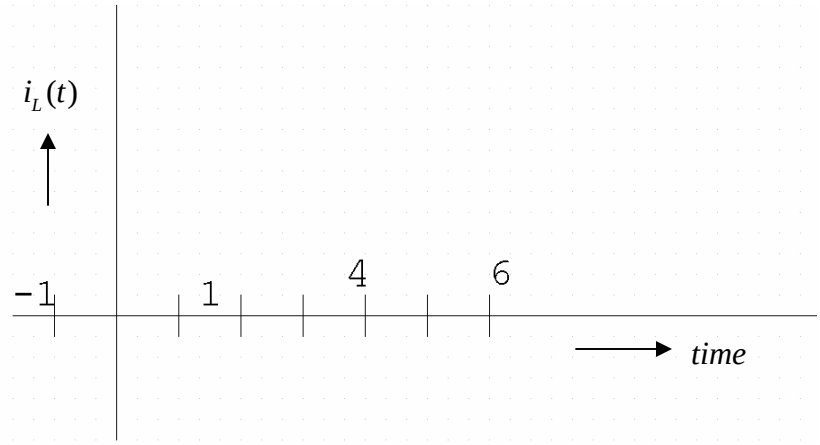


Figure 1 (b)

Problem 1(b) cont'd:



c) [7 points]: Determine the energy in joules stored in the inductor and the capacitor in fig. 1(c) assuming that the circuit is in steady state.

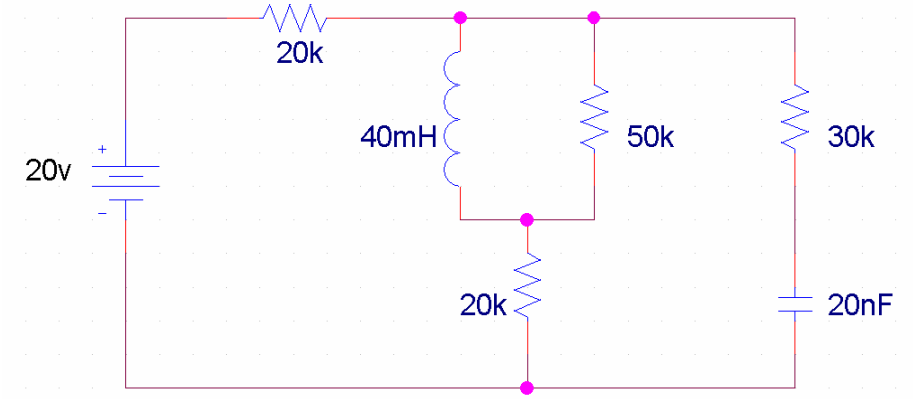


Figure 1 (c)

Energy stored in C: _____ Energy stored in L: _____

EXAM II **NAME:**
SPRING 2004 **SECTION 1 2 3**

Problem 2.

Consider the circuit in figure 2, which is in steady state at $t = 0^-$.

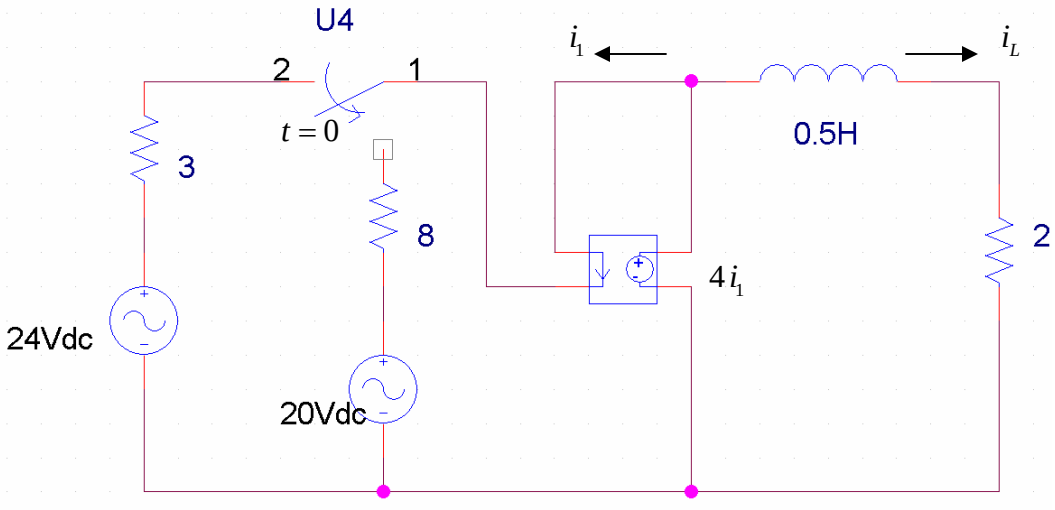


Figure 2

a) [6 points]: Determine $i_1(0^-)$ and $i_L(0^-)$.

$i_1(0^-) =$ _____ $i_L(0^-) =$ _____

Problem 2 cont'd.

b) [4 points]: Determine i_1 and i_L as $t \to \infty$.

$i_1(\infty) =$ _____ $i_L(\infty) =$ _____

c) [5+5 points]: Develop the differential equation with i_L as the variable and determine $i_L(t)$ for $0 \le t < \infty$.

D.E.: _____

EXAM II **NAME:**
SPRING 2004 **SECTION 1 2 3**

Problem 3.
For the circuit in figure 3:

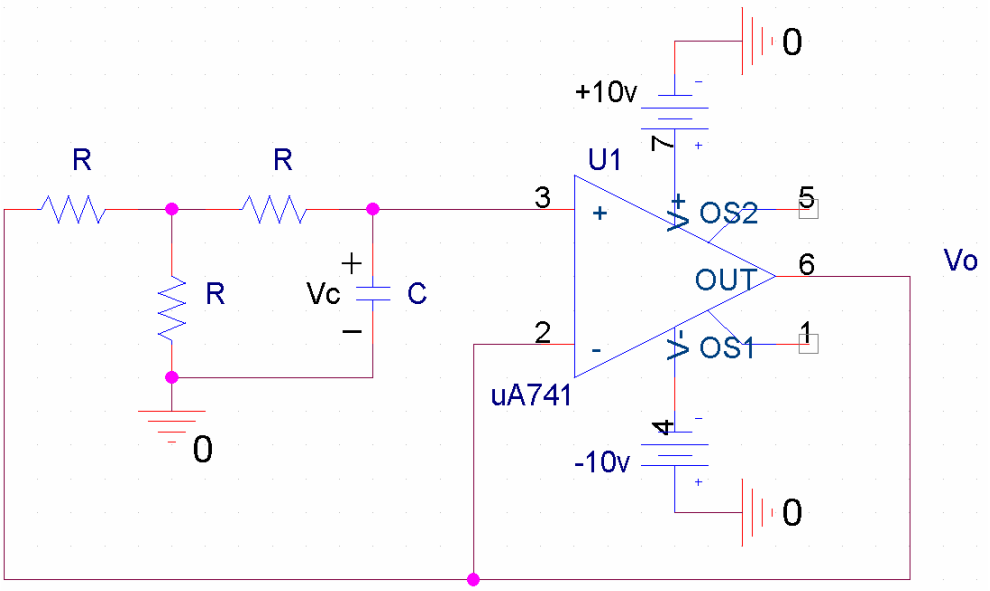


Figure 3.

a) [12 points]: Develop the differential equation in terms of R and C with $v_0(t)$ as the variable.

D.E.: _____

Problem 3 cont'd.

b) [4 points]: Write the form of the solution to the above differential equation. What is the time constant of the circuit?

$v_0(t) =$ _____ Time constant = _____

c) [4 points]: If $R = 50K\Omega,\ C = \frac{2}{3}nF,$ and $v_c(0) = 6$ volts, determine $v_0(t)$ for $0^+ \le t < \infty$.

$v_0(t) =$ _____

EXAM II **NAME:**
SPRING 2004 **SECTION 1 2 3**

Problem 4.
Assume that the circuit in figure 4 has been in steady state when the switch is opened at $t = 0$.

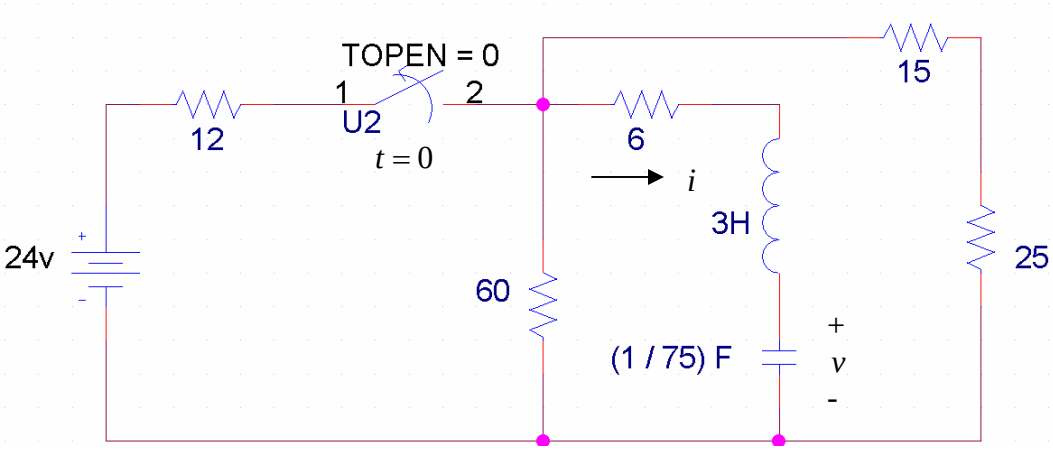


Figure 4.

a) [6 points]: Determine $i(0^-)$ and $v(0^-)$.

$i(0^-) =$ _____ $v(0^-) =$ _____

b) [4+3 points]: Write the differential equation for $v(t)$ for $0^+ \le t < \infty$, and determine the roots of the characteristic equation of the circuit.

Problem 4 (b) cont'd.

D.E.:_____ Roots: $s_1 =$_____ $s_2 =$_____

c) [4 points]: Write the solution $v(t)$ for $0^+ \le t < \infty$. You need not determine the unknown constants.

$v(t) =$ _____

d) [2 points]: What is the nature of the solution in part (c) above?

The solution is: _____

EXAM II **NAME:**
SPRING 2004 **SECTION 1 2 3**

Problem 5.

The output response of a circuit is defined by the differential equation:

$$\frac{d^2v}{dt^2}+10\frac{dv}{dt}+21v=42u(t), \quad v(0)=0,\ \dot{v}(0)=0$$

a) [4 points]: Show that $V(s)=\dfrac{42}{s(s^2+10s+21)}$

b) [12 points]: Determine $v(t)$ for $0\le t<\infty$.

$v(t)=$ _____

c) [4points]: Identify the following responses in the solution:

Natural response: _____

Steady State response: _____

Zero input response: _____

Zero state response: _____