## ECE 10, Winter 2021, Homework #5, Due March 5, 2021

**Problem 1:** Refer to Figure 1 for this problem. Assume that $R_1$ = 5 kΩ, $R_2$ = 16 Ω, L = 400 nH, C = 4 nF, and $V_0$ = 10 Volts. This is a continuation of Problem #6 from Homework #3 where you derived the differential equation in terms of i(t), and calculated the values of i(t), its first derivative, and its second derivative at time t = 0+. You are allowed to get all necessary information from the posted solutions to Problem #6 from Homework #3.

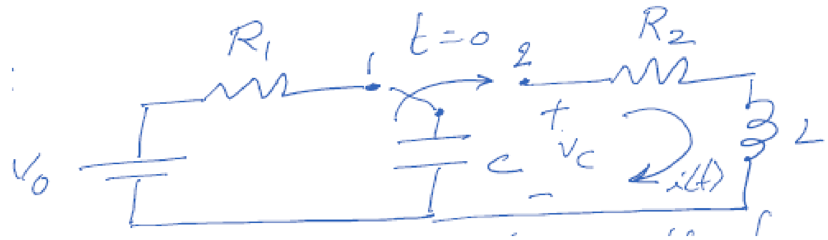


**Figure 1.**

**a.** Solve the differential equation and obtain an expression for i(t) for all time t ≥ 0.
**b.** Derive an expression for the voltage $v_C(t)$ for all time t ≥ 0.
**(10 + 5 = 15 points)**
**Solution:**

**Problem 2:** Consider the circuit shown in Figure 2. Assume that $C = 0.25F$, $L = 1H$, $R = 1$ Ohm, $V_B = 1V$, $v_C(0–) = 2V$, and $i_L(0–) = 1A$. Find expressions for $v_C(t)$ and $i_L(t)$ for time $t \geq 0$.

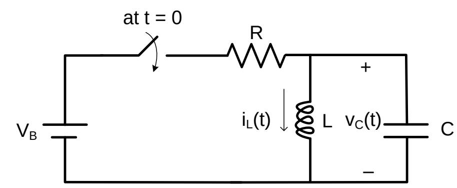


**Figure 2**

**(20 points)**

**Solution:**

**Problem 3: (Problem 6.15 from textbook)** Assume that $V_B$ = 100V, C = 10μF, R = 10Ohms, and L = 1H in Figure 3. In the network, the switch is closed, and a steady state is reached. Subsequently, at time t = 0, the switch is opened. Find an expression for the current in the inductor, $i_2(t)$ for time t ≥ 0.

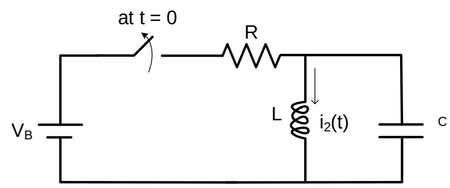

**Figure 3**

**(10 points)**
**Solution:**

**Problem 4:** Compute the phasors, if they exist, corresponding to the following signals.

a. $x(t) = -2\sin(50\pi t - 135°)$

b. $x(t) = 5\sin(340\pi t + 135°) - 12\cos(340\pi t - 60°)$

c. $x(t) = 4\sin(400\pi t - 135°) + 3\cos(4000\pi t - 60°)$

**(2 + 2 + 2 = 6 points)**

**Solution**:

**Problem 5:** Compute the sinusoidal signals corresponding to the following phasors.

a. $\underline{X} = 4 - j3 - 12/j$, $\omega = 7$ krad/s

b. $\underline{X} = 8e^{-j5\pi/6}$, $\omega = 10$ rad/s

**(2 + 2 = 4 points)**

**Solution:**

**Problem 6:** Refer to the circuit schematic shown in Figure 4. Assume that L = 2nH, C = 5pF, and R = 50 Ohms.

(a) Find the equivalent impedance, Z, looking into 1-1' when f = 2 GHz.

(b) Suppose a current source, $i_B(t) = 2\cos(4\pi \times 10^9 t)$ Amperes, is applied between 1 and 1' nominally flowing into 1 and out of 1'. Using phasor analysis, calculate the phasors, $\underline{V}_C$, $\underline{V}_X$, $\underline{I}_R$, and $\underline{I}_L$, that correspond to $v_C(t)$, $v_R(t)$, $i_R(t)$, and $i_L(t)$, respectively.

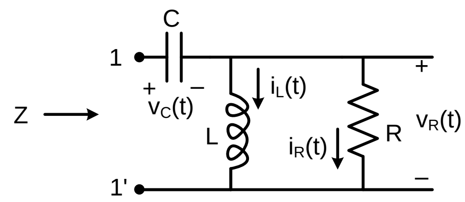


**Figure 4.**

(c) Draw a phasor diagram for this circuit, i.e., sketch the phasors $\underline{V}_C$, $\underline{V}_X$, $\underline{I}_R$, and $\underline{I}_L$, on a complex plane

(d) Derive expressions for the steady state time-domain signals, $v_C(t)$, $v_R(t)$, $i_R(t)$, and $i_L(t)$.

**(10 + 15 + 4 + 6 = 35 points)**

**Solution:**