Homework 3

This homework is due on Friday, September 16, 2022 at 11:59PM. Self-grades and HW Resubmissions are due the following Friday, September 23, 2022 at 11:59PM.

1. **Hambley P4.61**

   A DC source is connected to a series RLC circuit by a switch that closes at $t = 0$, as shown in Figure 1. The initial conditions are $i(0+) = 0$ and $v_C(0+) = 0$. Write the differential equation for $v_C(t)$. Solve for $v_C(t)$ given that $R = 80\,\Omega$.

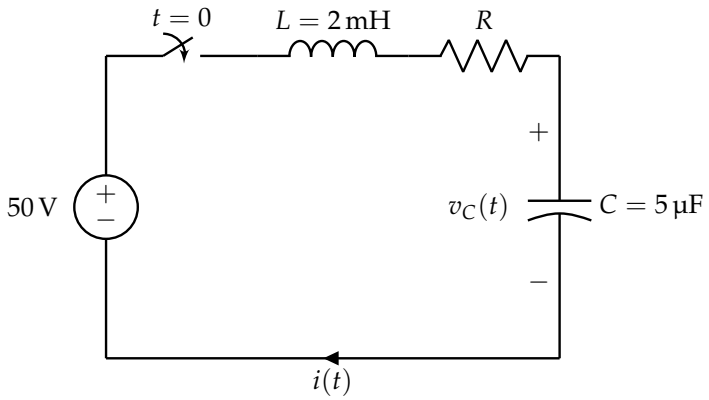

Figure 1: P4.61

2. Hambley P4.64

Consider the circuit shown in Figure 2, with $R = 25\,\Omega$.

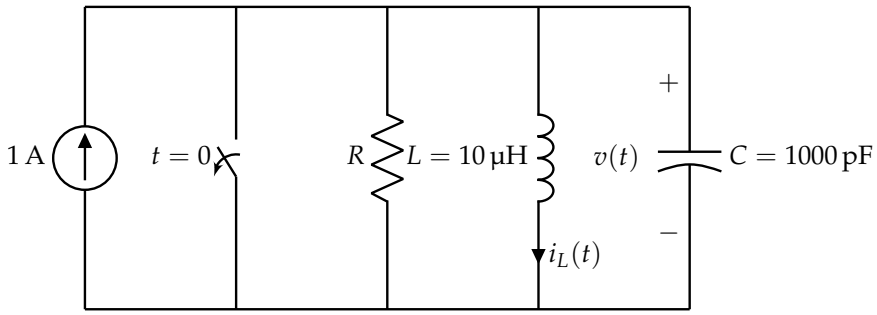

Figure 2: P4.64

(a) Compute the undamped resonant frequency, the damping coefficient, and the damping ratio.

(b) The initial conditions are $v(0+) = 0$ and $i_L(0+) = 0$. Show that this requires $v'(0+) = 10^9 \frac{\text{V}}{\text{s}}$.

(c) Find the particular solution for $v(t)$.

(d) Find the general solution for $v(t)$, including the numerical values of all parameters.

3. Hambley P5.15

Determine the rms value of $v(t) = A\cos(2\pi t) + B\sin(2\pi t)$.

4. Hambley P5.22

Suppose that $v_1(t) = 100\cos(\omega t)$ and $v_2(t) = 100\sin(\omega t)$. Use phasors to reduce the sum $v_s(t) = v_1(t) + v_2(t)$ to a single term of the form $V_m\cos(\omega t + \theta)$. Draw a phasor diagram, showing V_1, V_2, and V_s. State the phase relationships between each pair of these phasors.

5. Hambley P5.23

Consider the phasors shown in Figure 3. The frequency of each signal is $f = 200\,\text{Hz}$. Write a time-domain expression for each voltage in the form $V_m \cos(\omega t + \theta)$. State the phase relationships between pairs of these phasors.

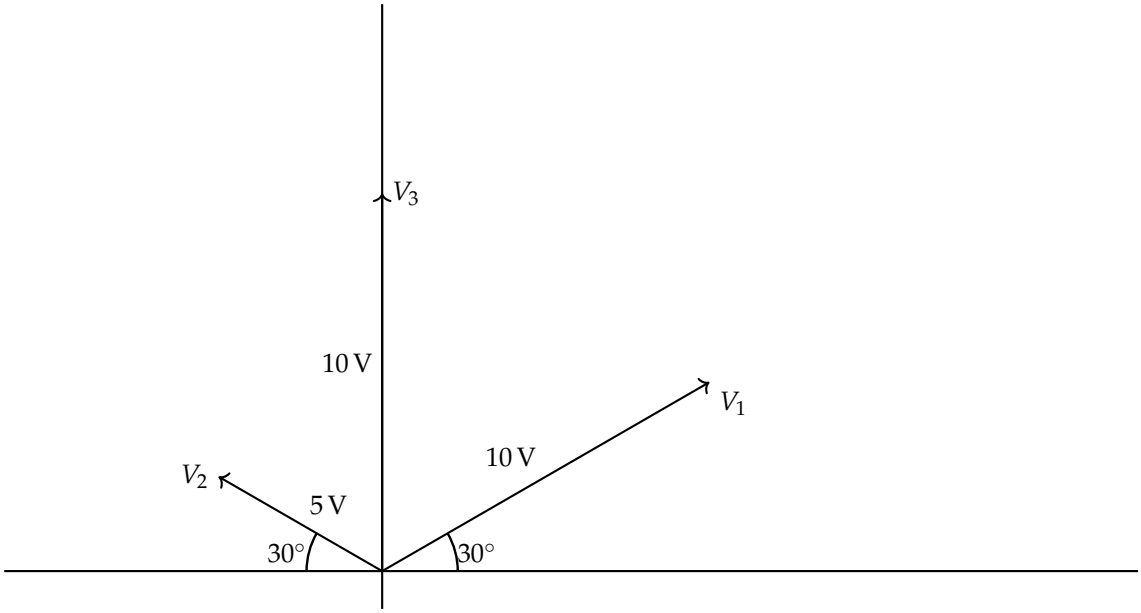

Figure 3: P5.23

6. Hambley P5.32

A voltage $v_L(t) = 10\cos(2000\pi t)$ is applied to a 100 mH inductance. Find the complex impedance of the inductance. Find the phasor voltage and current, and construct a phasor diagram. Write the current as a function of time. Sketch the voltage and current to scale versus time. State the phase relationship between the current and voltage.

7. Hambley P5.33

A voltage $v_C(t) = 10\cos(2000\pi t)$ is applied to a 10 µF capacitance. Find the complex impedance of the capacitance. Find the phasor voltage and current, and construct a phasor diagram. Write the current as a function of time. Sketch the voltage and current to scale versus time. State the phase relationship between the current and voltage.

8. Hambley P5.38

Find the phasors for the current and the voltages for the circuit shown in Figure 4. Construct a phasor diagram showing V_s, I, V_R, and V_L. What is the phase relationship between V_s and I?

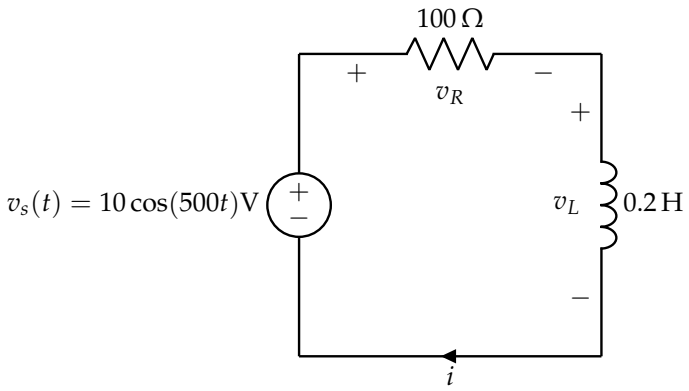

Figure 4: P5.38

