Homework 3

This homework is due on Friday, February 10, 2023 at 11:59PM. Self-grades and HW Resubmissions are due the following Friday, February 17, 2023 at 11:59PM.

1. **(OPTIONAL) Study Group Reassignment**

   We hope your study groups from the beginning of the semester have been going well! If you did not fill out the original matching form and would now like to join a group, or if your current study group is not meeting your needs, you can request a new study group via this form. Requests for new study groups are due Friday at 11:59 PM.

2. Hambley P3.49

The current in a 100 mH inductance is given by $0.5\sin(1000t)$A. Find expressions and sketch the waveforms to scale for the voltage, power, and stored energy, allowing t to range from 0 to 3π ms. The argument of the sine function is in radians.

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3. **Hambley P3.55**

   What value of inductance corresponds to an open circuit, assuming zero initial current? Explain your answer. Repeat for a short circuit.

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4. Hambley P3.74

A pair of mutually coupled inductances has $L_1 = 2\,\text{H}$, $L_2 = 1\,\text{H}$, $i_1 = 2\cos(1000t)\text{A}$, $i_2 = 0$, and $v_2 = 2000\sin(1000t)\text{V}$. (The arguments of the sine and cosine functions are in radians.) Find $v_1(t)$ and the magnitude of the mutual inductance.

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5. Hambley P4.21

Solve for the steady-state values of i_1, i_2, and i_3 in the circuit shown in Figure 1.

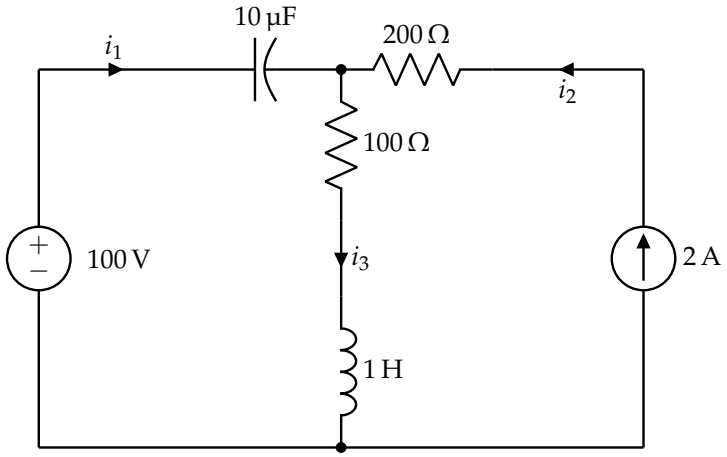

Figure 1: P4.21

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6. Hambley P4.41

Determine expressions for and sketch $v_R(t)$ to scale versus time for the circuit of Figure 2. The circuit is operating in steady state with the switch closed prior to $t = 0$. Consider the time interval $0 \leq t \leq 1$ ms.

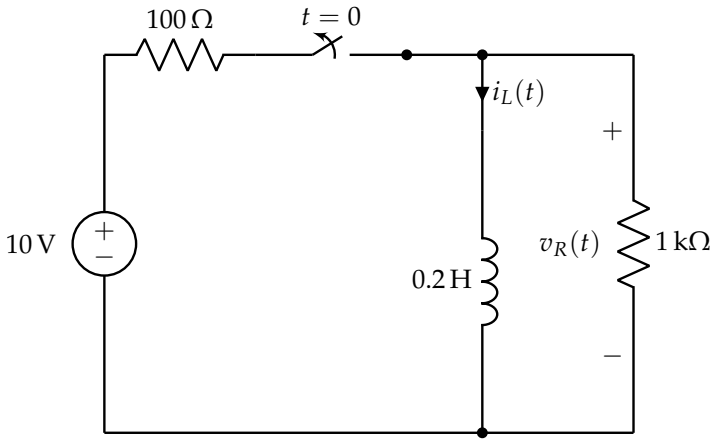

Figure 2: P4.41

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7. 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 3. The initial conditions are $i(0+) = 0$ and $v_C(0+) = 25$. Write the differential equation for $v_C(t)$. Solve for $v_C(t)$ given that $R = 80\,\Omega$.

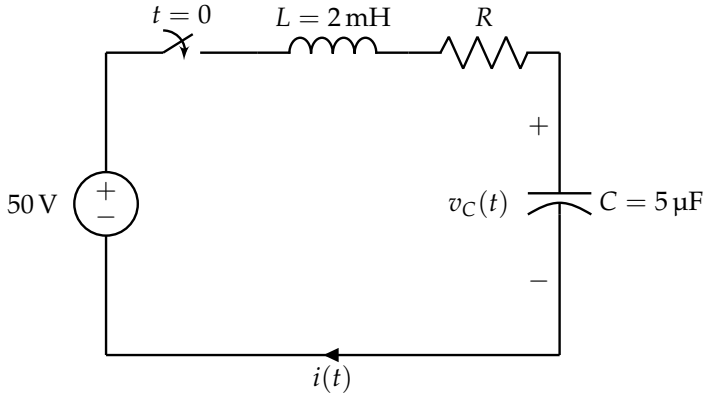

Figure 3: P4.61

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8. Hambley P4.64

Consider the circuit shown in Figure 4, with $R = 25\,\Omega$.

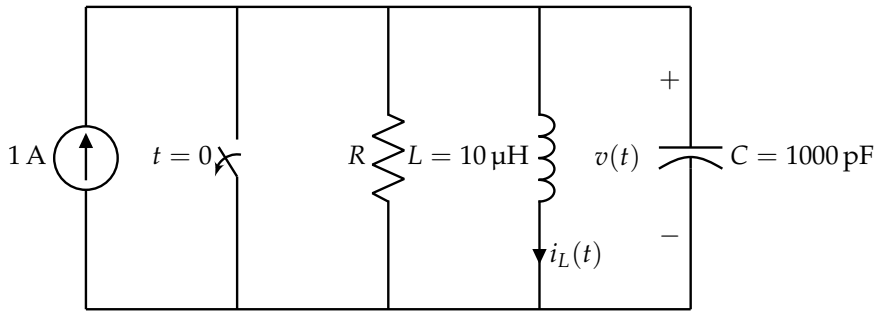

Figure 4: P4.64

(a) Compute the undamped resonant frequency, τ, and ζ.

(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.

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