Discussion 2B

The following sections from the textbook are useful for this discussion: Sections 4.1, 4.3, 4.4

1. RL Transient Analysis (Hambley Example 4.2)

Consider the circuit shown in Figure 1.

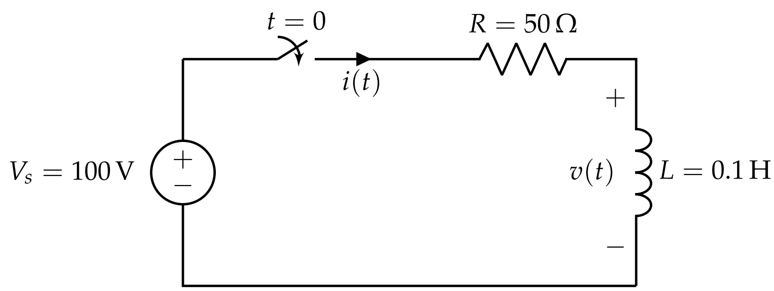

Figure 1

(a) **Set up a differential equation for the current $i(t)$ in the form:**

$$\frac{\mathrm{d}i(t)}{\mathrm{d}t} + ai(t) = b(t) \tag{1}$$

and determine the initial condition $i(0)$.

(b) **Solve for the current $i(t)$ using the integrating factor method.**

(c) **Find the voltage $v(t)$.**

2. Analyzing an RC Circuit with a Sinusoidal Source (Hambley Example 4.4)

Assume you are given the following circuit, where the capacitor is initially charged so that $v_C(t) = 1V$.

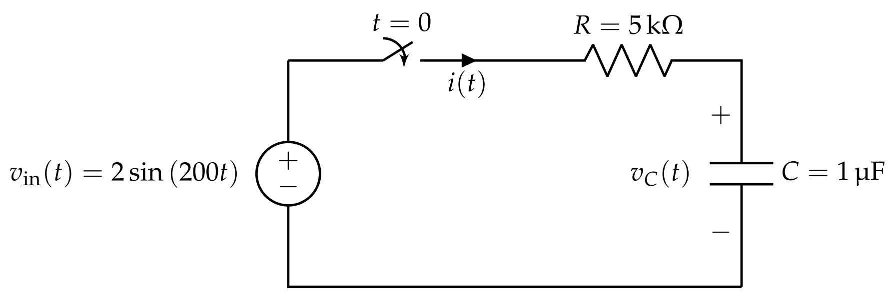

Figure 2

(a) **Set up a differential equation for the current $i(t)$ through the circuit in the form:**

$$\frac{\mathrm{d}i(t)}{\mathrm{d}t} + ai(t) = b(t) \tag{2}$$

(b) **Determine the initial condition of $i(t)$. In order words, solve for $i(0)$.**

(c) **Solve for the current $i(t)$ through the circuit. Also, identify the transient response and the forced response of $i(t)$.** You may directly use the fact that the solution to a differential equation in the same form as Equation 2 is:

$$i(t) = A\mathrm{e}^{-at} + \mathrm{e}^{-at} \int \mathrm{e}^{at'} b(t')\,\mathrm{d}t' \tag{3}$$

(HINT: The following integral might be useful:

$$\int e^{at} \cos(bt) = \frac{1}{b^2 + a^2} \mathrm{e}^{at} (b \sin(bt) + a \cos(bt)) \tag{4}$$

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(d) **(OPTIONAL) Solve for the voltage $v_C(t)$ across the capacitor.**