Final Examination

Notice: Please **turn off any types of handheld devices**, and leave them far from reach. Use only standalone calculators for calculation if it is needed. The examination takes **110 minutes**.
只需繳回答案紙，題目紙請同學保留。

1. (10%) Find the governing differential equation for current i_2 in the circuit shown in Fig. 1.

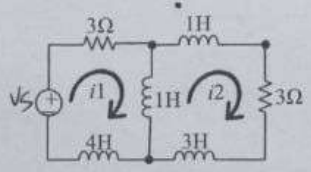

Fig.1

2. (11%) For the circuit shown in Fig. 2, suppose $R = 0.2\Omega$, $L = 1/12$H, $C = 0.5$F, $v(0) = 20$V, and $i(0) = 11$A:

   (a) Find the natural response of $v(t)$ for $t > 0$, and determine this circuit as either overdamped, critically damped, or underdamped?

   (b) If we want this circuit to be critically damped by changing the value of C and keeping R and L with their original values, please determine the value of C. (取至小數點第三位)

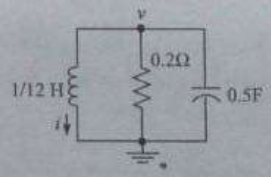

Fig.2

3. (10%) Find the forced response i_f for the inductor current i in the circuit shown in Fig. 3 when $i_s = 15e^{-6t}$A. Let $R = 8\Omega$, $L = 10$H, and $C = 1/40$F.

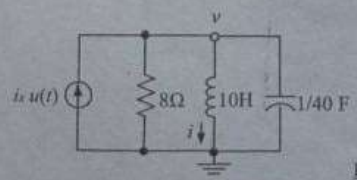

Fig. 3

4. (11%) Determine the voltage $v_o(t)$ while the AC source input in the circuit shown in Fig. 4 is:

$$v_S(t) = 10\cos(1500t + 37^\circ)\text{V}$$

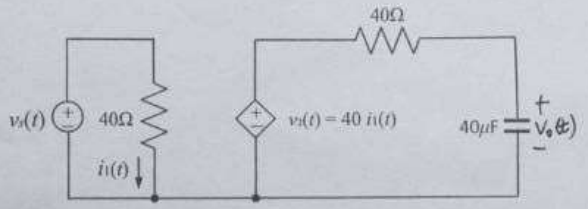

Fig. 4

5. (12%) Determine the output voltage $v_o(t)$ in the circuit shown in Fig. 5, when the AC source input is:

$$v_S(t) = 200\cos(10^4 t + 30^\circ)\text{mV}$$

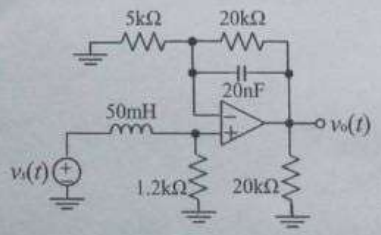

Fig. 5

6. (10%) Find Thévenin equivalent circuit of the AC circuit shown in Fig. 6.

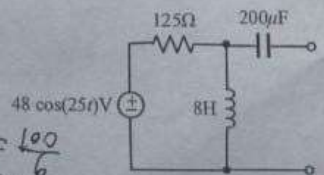

Fig. 6

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7. (10%) Determine the voltage $v_o(t)$ across the 9Ω resistor in the circuit shown in Fig. 7.

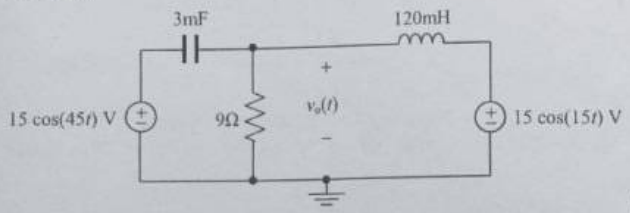


Fig. 7

8. (11%) Determine the network function, $\mathbf{H}(\omega) = \frac{\mathbf{V_o}(\omega)}{\mathbf{V_s}(\omega)}$, of the circuit shown in Fig. 8 while the input voltage is v_s, the output voltage is v_o.

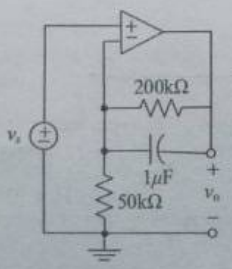


Fig. 8

9. (15%) Find the complete response $v(t)$ for $t > 0$ for the circuit of Fig. 9. Assume the circuit is at steady state at $t = 0^-$.

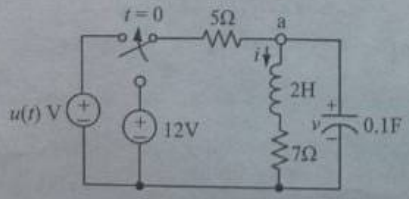
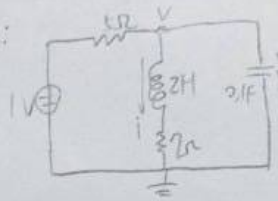


Fig. 9

$t>0$:



$\frac{V-1}{5} + i + 0.1V(t) = 0 \rightarrow i(t) = -0.1V(t) - \frac{V-1}{5}$

$V = 2i(t) + 7i$

$V = 2\left(-0.1V'(t) - \frac{V(t)}{5}\right) + 7\left(-0.1V'(t) - \frac{V-1}{5}\right)$

$V = -0.2V'(t) - 0.4V(t) - 0.7V(t) - \frac{7(V-1)}{5}$

$V = -0.2V'(t) - 1.1V'(t) - \frac{15}{5}V + \frac{7}{5}$

$0.2V'(t) + 1.1V'(t) + \frac{12}{5}V(t) = \frac{+7}{5}$

$0.2s^2 + 1.1s + \frac{12}{5} = 0$

$0.2s$

$2s^2 + 11s + 24 = 0$

$s \quad 4 \quad 3$