Midterm 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 **90 minutes**.只需繳回答案紙，題目紙請同學保留。

1. (11%) Represent the circuit shown in Fig. 1 by a differential equation for $t > 0$, when the input is v_s and the output is $i_2(t)$ of the inductor.

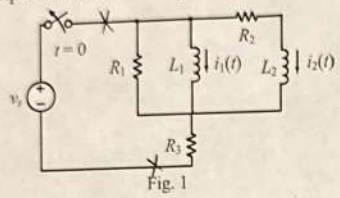

Fig. 1

2. (11%) Determine the values of L and R_2 considering the circuit shown in Fig. 2(a) and its corresponding plot of voltage across the 40Ω resistor shown in Fig. 2(b).

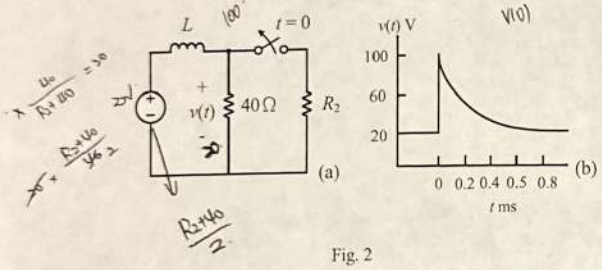

Fig. 2

3. (10%) Find current $i(t)$ of a circuit with sequential switches shown in Fig. 3. While the first switch activates at $t = 1$ms, the second activates at $t = 2$ms.

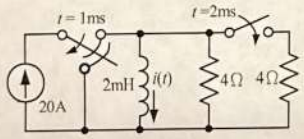

Fig. 3

4. (11%) The circuit in Fig. 4 contains a dependent current controlled current source (CCCS). What restriction shall be added on the gain B to guarantee the stability of the circuit?

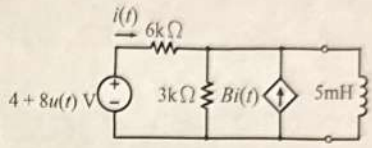

Fig. 4

5. (11%) Determine $v(t)$ for $t > 0$ when the voltage $v_s(t)$ in the circuit shown in Fig. 5 is $v_s(t) = 7 - 14u(t)$V.

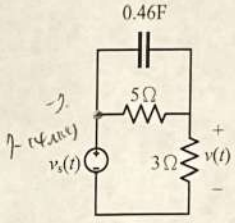

Fig. 5

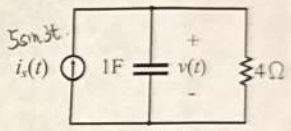

Fig. 6

6. (11%) Find the response $v(t)$ for the circuit shown in Fig. 6. The initial voltage $v(0) = 0$, and the current source is $i_s = 5\sin 3t$.

7. (10%) For a 1H inductor with $v(0) = 0$ and $i(0) = 0$:

   (a). Determine $v(t)$ when $i(t) = x(t)$, where $x(t)$ is charted in Fig. 7 and $i(t)$ has units of A.

   (b). Determine $i(t)$ when $v(t) = x(t)$, where $x(t)$ is charted in Fig. 7 and $v(t)$ has units of V.

(There are questions on the back)

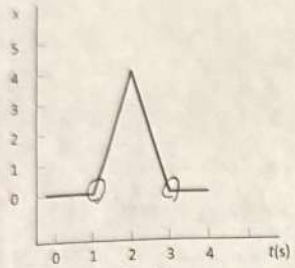

Fig. 7

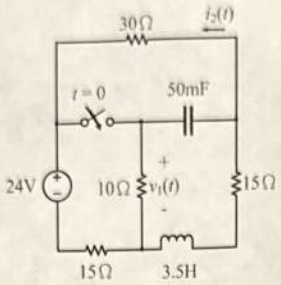

Fig. 8

8. (10%) Determine $v_1(0^-)$, $v_1(0^+)$, $i_2(0^-)$ and $i_2(0^+)$ of the circuit shown in Fig. 8 which is already at steady state when the switch closes at time $t = 0$.

9. (15%) Design a circuit to represent a linear differential equation:

$$\frac{d^2}{dt^2}y(t) + 2\frac{d}{dt}y(t) + 3y(t) = 2x(t)$$

via operation amplifiers along with resistors and capacitors. To simplify the design, assign $C = 1\mu F$ and $R = 1M\Omega$ in every elementary integrators, and $R_i = 20k\Omega$ in every inverting and non-inverting amplifiers.