1. For the circuit shown in Fig. 1, please use **Nodal analysis** to determine: (a) the node voltage V_1 and V_2, and (b) the power **supplied** by the dependent current source <$3i_1$>. [20]

2. For the circuit shown in Fig. 2, the supply voltages of the op-amp are: $+V_{CC}$= 15V and $-V_{CC}$= -15V. The values of the resistors are: R_1= 2kΩ, R_2= 1kΩ, R_3= 1kΩ, R_4= 2kΩ. The input voltages are v_1=1.5V and v_2=2V. (a) Please determine the output voltage v_o. (b) if the resistors are changed to R_1= 1kΩ, R_2= 0.5kΩ, R_3= 1kΩ, R_4= 14kΩ and the input voltages remains the same, please determine the output voltage v_o. [15]

3. The circuit shown in Fig. 3 has L=200μH, C=27μC, and R=5Ω. The time-domain differential equation can be derived as (1) and the frequency-domain equation can be derived as (2).

$$X \cdot \frac{d^2 v_c}{dt^2} + Y \cdot \frac{dv_c}{dt} + Z \cdot v_c = K \quad \cdots\cdots (1)$$

$$U \cdot s^2 v_c(s) + V \cdot s v_c(s) + W \cdot v_c(s) = J \quad \cdots\cdots (2).$$

Please answer the following questions: (a) Determine the values for X, Y, Z, K, U, V, W, and J. [15]; (b) Determine the frequency-domain transfer function H(s)= v_o(s)/v_i(s). [5]; (c) Draw the Bode plot (both magnitude and phase) of H(s). [10] (d) If the input voltage is $v_i(t)$ = 110 sin (377t) V, what is the out voltage $v_o(t)$=? [5] (e) If the input voltage is $v_i(t)$ = 110 sin (13600t) V, what is the out voltage $v_o(t)$=? [5]

4. For the circuit shown in Fig. 4 the input current i_{in} = 3A for t <0 and i_{in} = -1A for $t \geq 0$. (a) Please determine the s-domain expression of inductor current I_L(s). (b) Determine the time-domain inductor current i_L(t). [20]

5. Please explain the principle of superposition. [5]

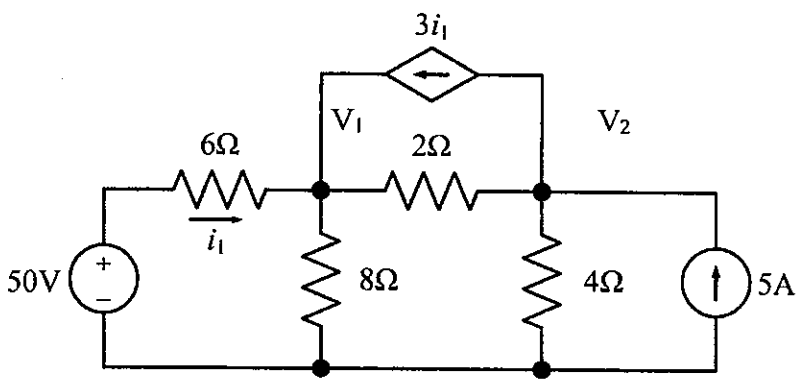

Fig. 1

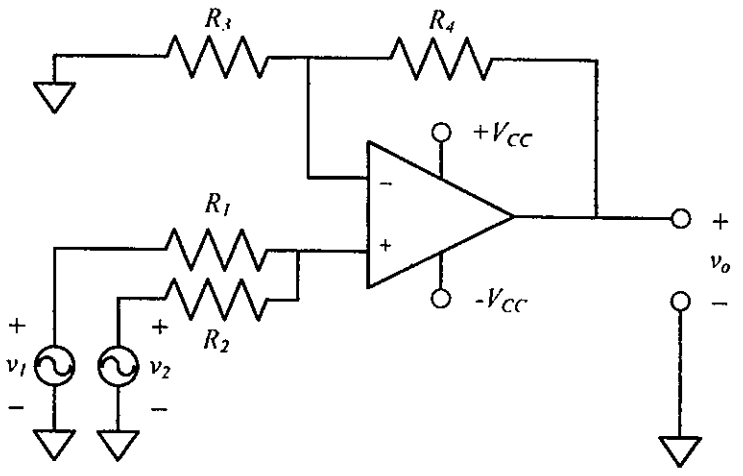

Fig. 2

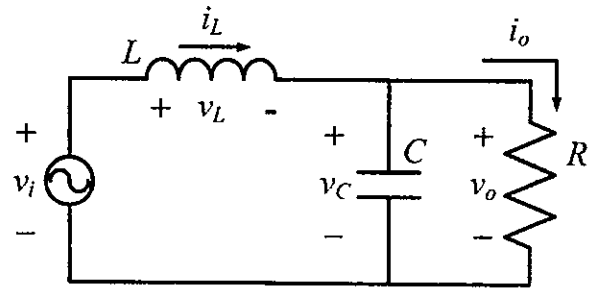

Fig. 3

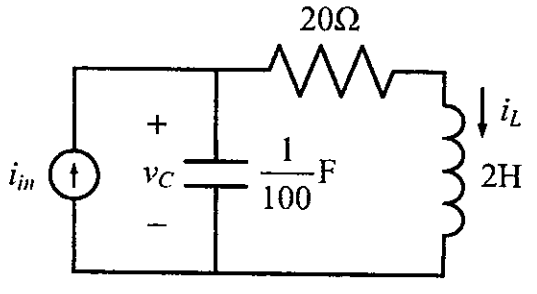

Fig. 4

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