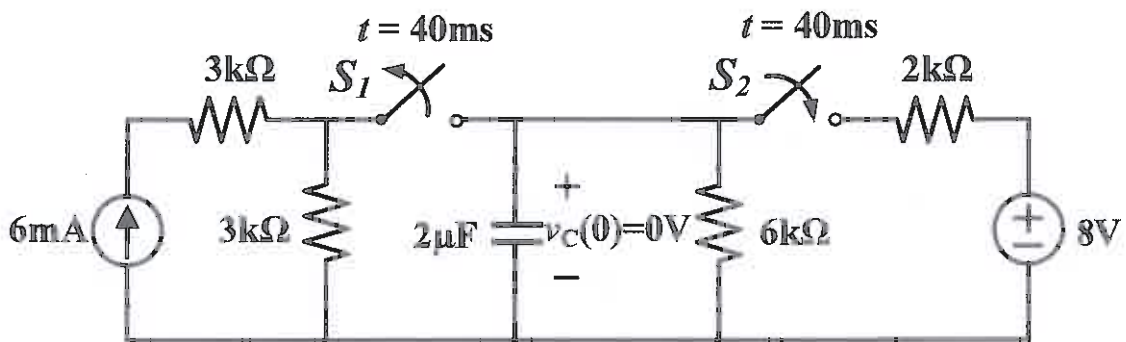


※請在答案卷內作答

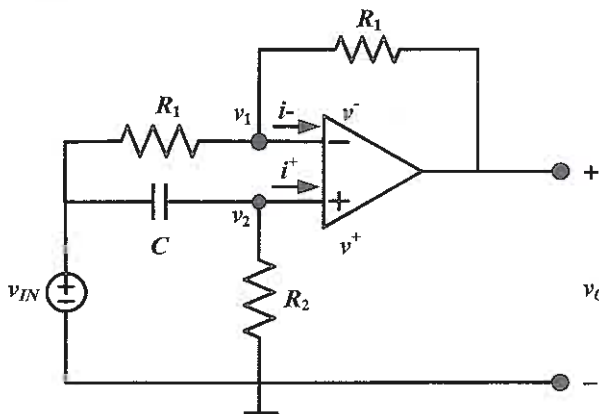
1. For the circuit as shown in the following figure, the switch S_1 has been opened for a long time before it is closed at $t = 0$ and reopened at $t = 40\text{msec}$, the switch S_2 has been opened for a long time before it is closed at $t = 40\text{msec}$.

- (a) Find the time constant τ_1 of this circuit for $0 < t < 40\text{ms}$ when S_1 is closed and S_2 is opened. (3%)
- (b) Find the time constant τ_2 of this circuit for $t > 40\text{ms}$ when S_1 is opened and S_2 is closed. (3%)
- (c) Sketch $v_C(t)$ for $0 \leq t \leq 70\text{ms}$. (4%)

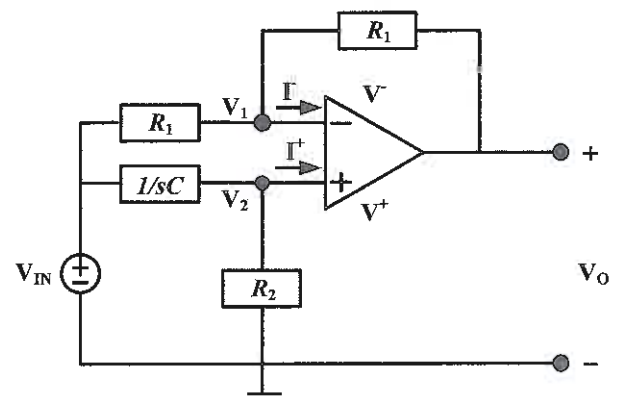


2. For the active filter circuit along with its impedance model as shown in the following figures,

- (a) Write down the node equations for V_1 and V_2 of the impedance model. (3%)
- (b) For sinusoidal steady-state response, find the transfer function $H(j\omega) = V_O(j\omega)/V_{IN}(j\omega)$ for this circuit (where $s = j\omega$). (4%)
- (c) Is this RC active filter a low-pass, high-pass, all-pass or bandpass filter? (3%)



(1) Circuit



(2) Impedance model

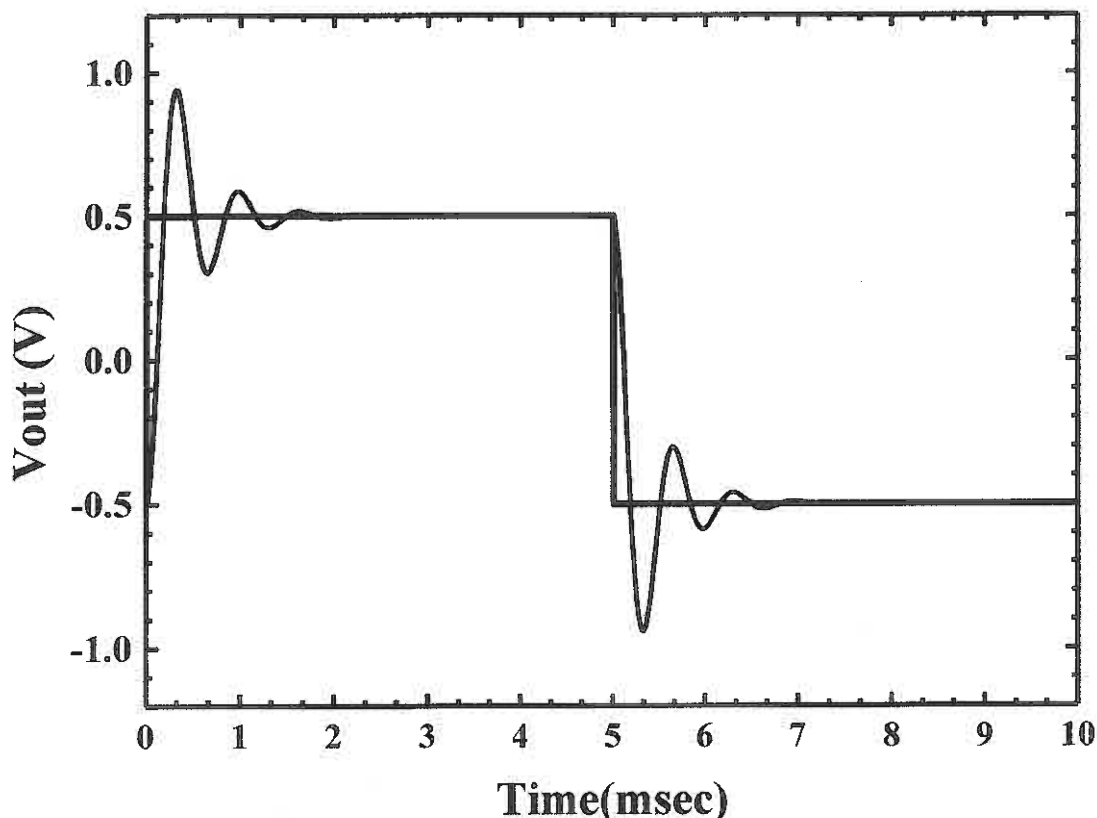
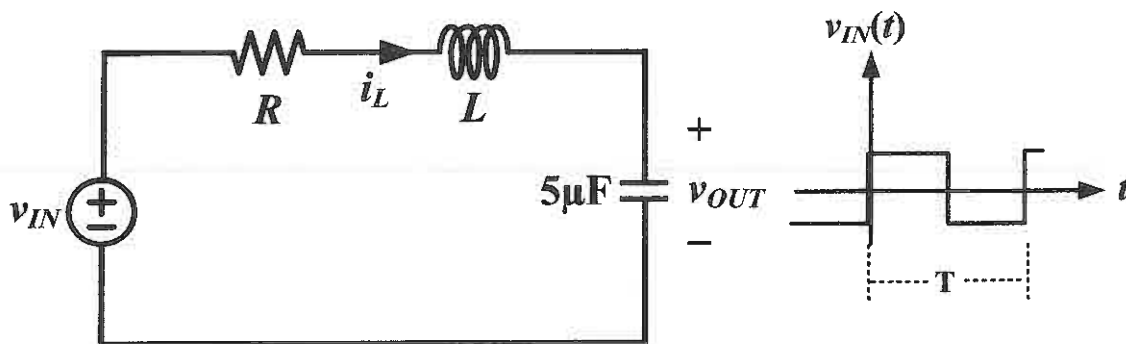
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參考用

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3. For the RLC circuits as shown, this circuit is under a 100 Hz square wave excitation. The excitation and the response for the capacitor are also shown in the figure below. It is known that the capacitance is equal to $5\mu\text{F}$. From the information given, answer the following questions.

- (a) What is the approximate inductance of the inductor in this circuit? (4%)
- (b) What is the approximate resistance of the resistor in this circuit? (4%)
- (c) If a 100Ω resistor is used in this circuit, what will the response of this circuit become? Under-damped, over-damped, or critically-damped? (2%)

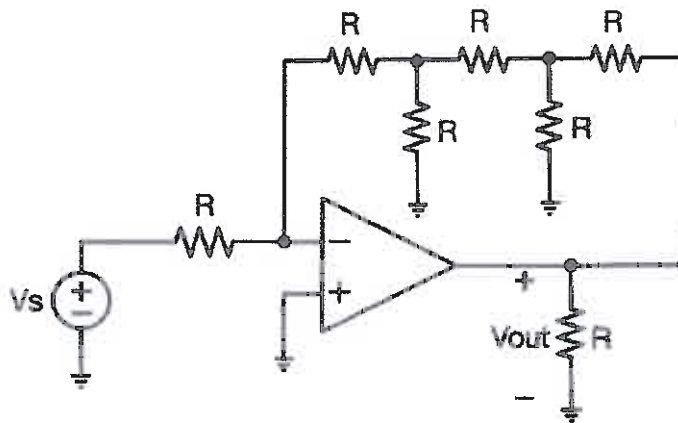


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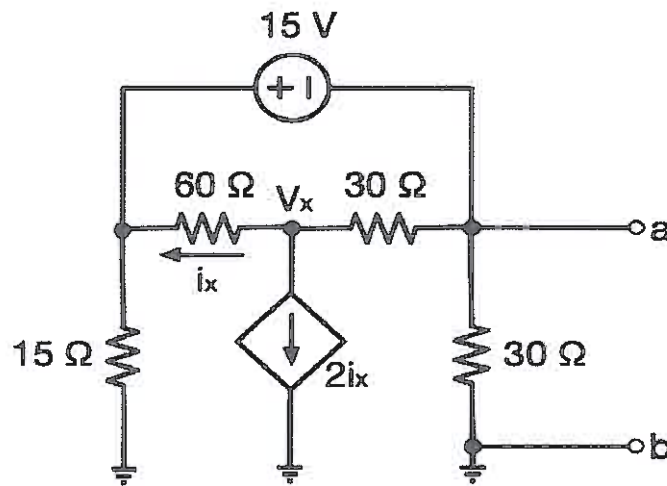
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4. Consider the circuit shown in the following figure. The operational amplifier is ideal with infinite input impedance, zero output impedance, and its voltage gain A is very large, where $V_{out} = A(V^+ - V^-)$. All of the resistors have the same resistance R . Find the voltage gain V_{out}/V_s . (10%)



參考用

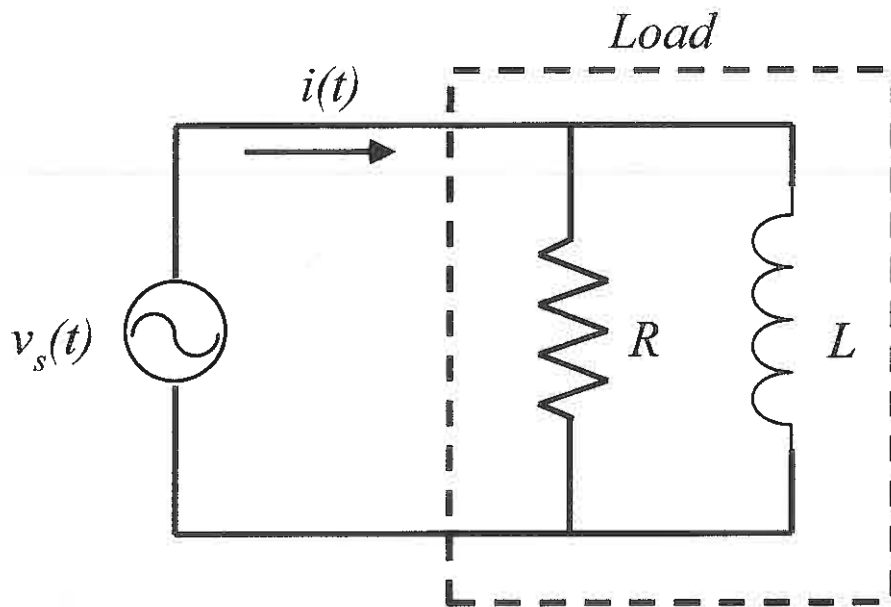
5. Consider the circuit in the following figure. Determine the power dissipated by the dependent source (5%), and the Thevenin equivalent circuit with respect to the terminals a and b (15%).



注意：背面有試題

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6. The load consisting of a resistor and an inductor in the given circuit is connected to an AC voltage source $v_s(t) = 141\cos(377t)$, and it consumes 5kW with a lagging power factor of 0.8.
- Calculate the current $i(t)$ consumed by this load (5%).
 - Calculate the values of R and L (5%).
 - Find a way to raise the load power factor to 1.0. Please draw the circuit diagram of your solution and provide analysis to validate it (5%).
 - Please discuss the advantage or disadvantage of raising the load power factor from 0.8 to 1.0(5%).



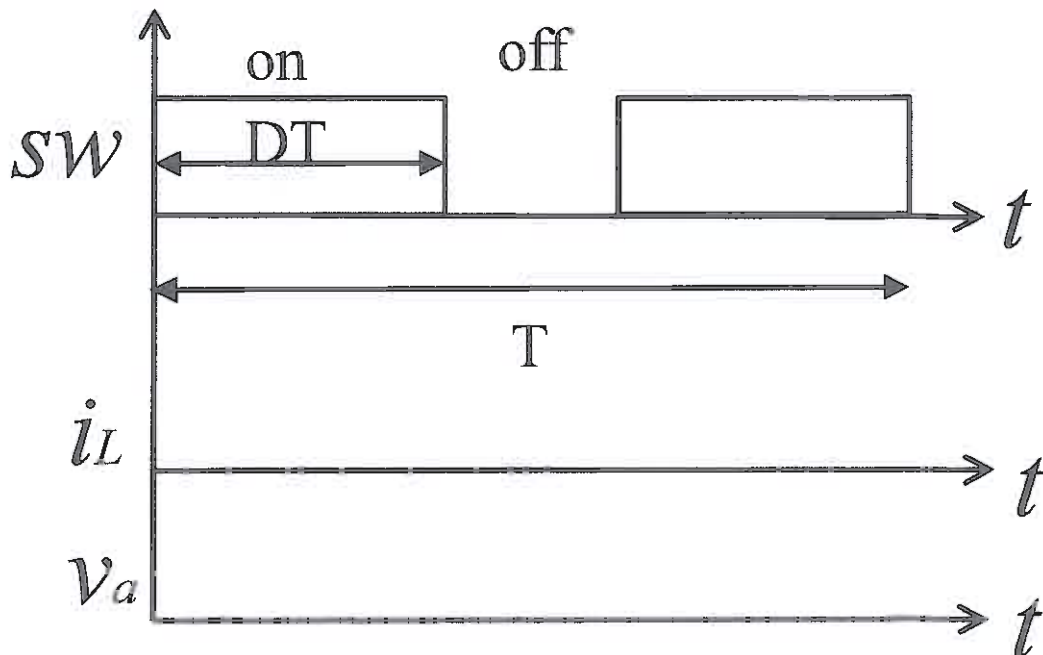
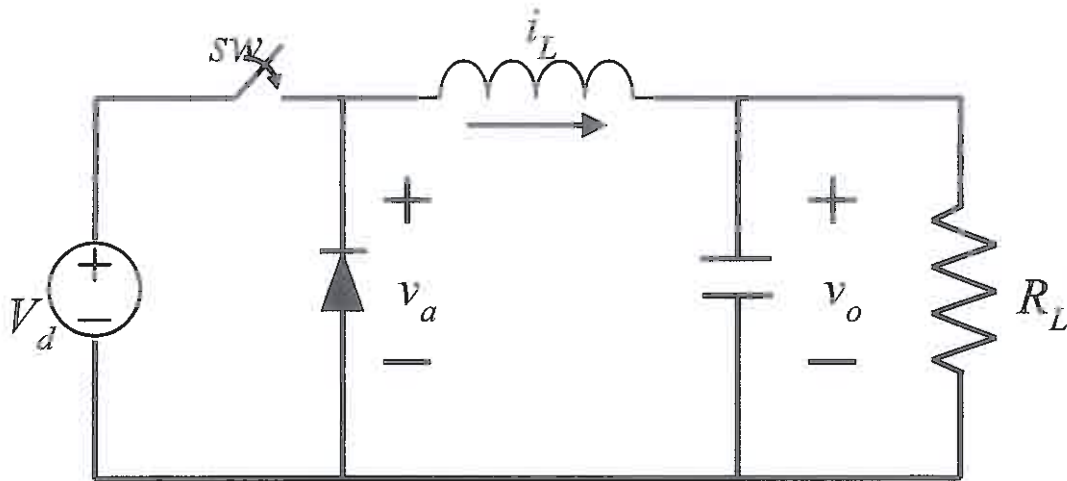
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7. The circuit diagram of a step-down converter is as given. The input voltage V_d is 12 VDC, the average output voltage V_o is 5VDC, and the load resistor R_L is 500ohm. The switching frequency of the switch is 25kHz. Assuming the circuit operates in the continuous conduction mode.

- Sketch the waveforms of v_a and i_L (5%).
- Calculate the duty ratio D . Please show the circuit analysis of this calculation (5%).
- What is the minimum value of the inductor L for maintaining continuous conduction mode (CCM) of operation of this circuit? Please show your analysis (5%).
- If the load resistor R_L increases to 1000ohm, will this circuit remain in the CCM operation with the minimum value of L (Yes/No)? Please explain your answer (5%).



參考用