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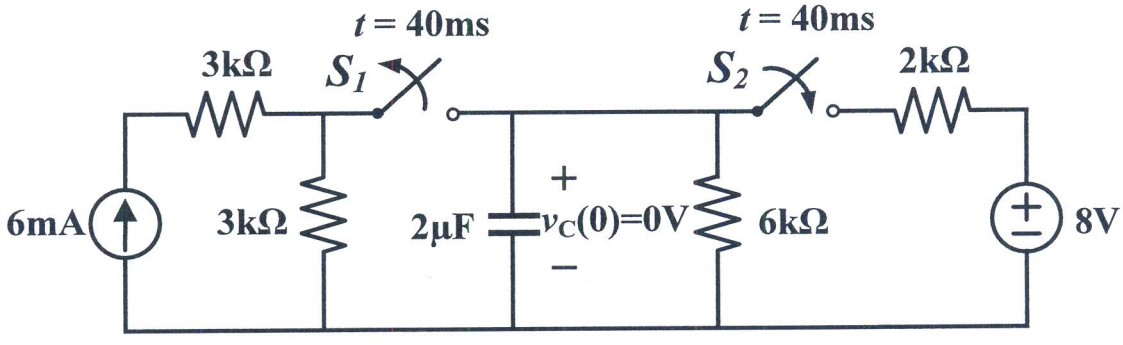
※請在答案卷內作答

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 $t = 40$msec, the switch S_2 has been opened for a long time before it is closed at $t = 40$msec.

(a) Find the time constant τ_1 of this circuit for $0 < t < 40$ms when S_1 is closed and S_2 is opened. (3%)

(b) Find the time constant τ_2 of this circuit for $t > 40$ms when S_1 is opened and S_2 is closed. (3%)

(c) Sketch $v_C(t)$ for $0 \le t \le 70$ms. (4%)

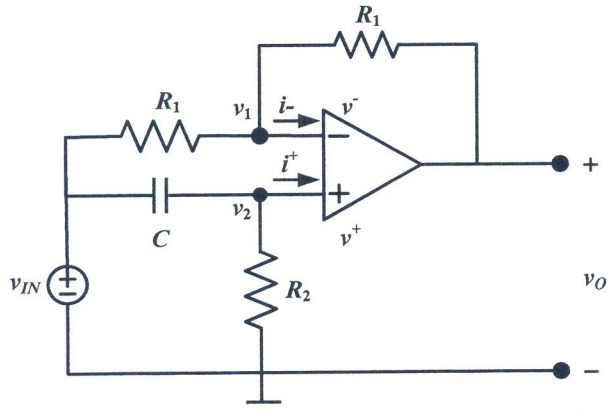


2. For the active filter circuit along with its impedance model as shown in the following figures,

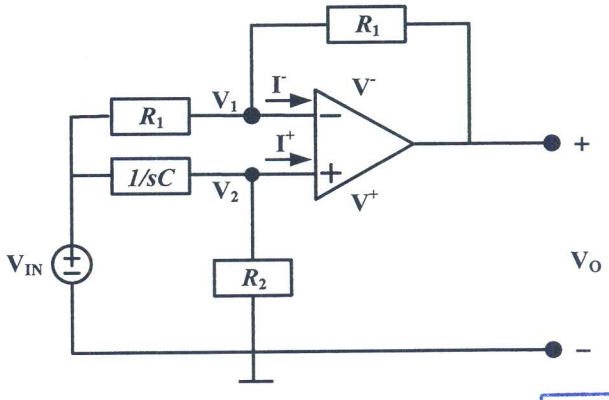
(a) Write down the node equations for $\mathbf{V}_1$ and $\mathbf{V}_2$ of the impedance model. (3%)

(b) For sinusoidal steady-state response, find the transfer function $\mathbf{H}(j\omega) = \mathbf{V}_O(j\omega)/\mathbf{V}_{IN}(j\omega)$ 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

注意：背面有試題

參考用

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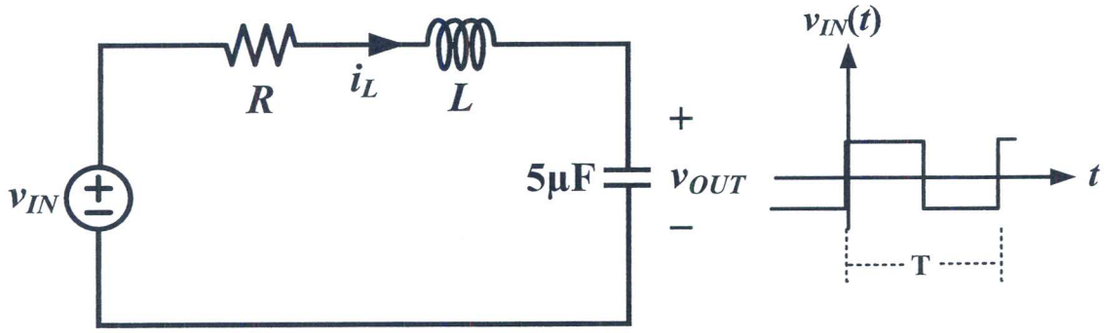
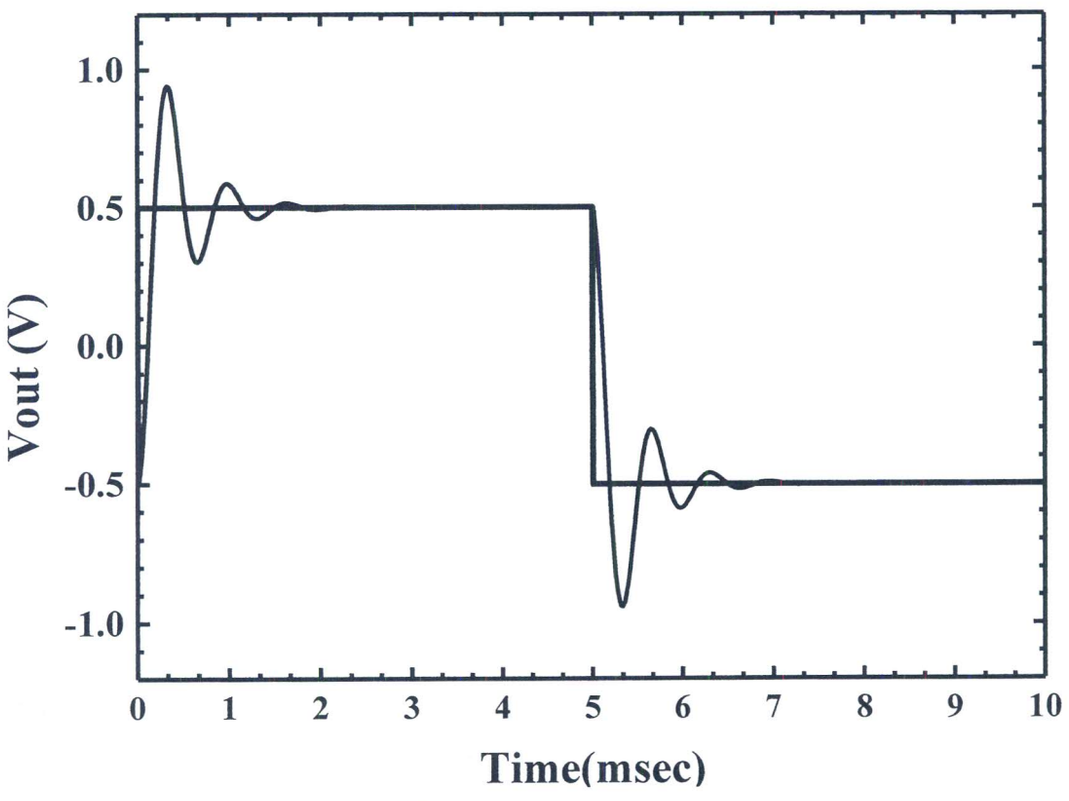
3. For the RLC circuits as shown, this circuit is under a 100 Hz square wave excitation. The excitation and the response for the capacitator are also shown in the figure below. It is known that the capacitance is equal to 5μF. From the information given, answer the following questions.

(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%)





注意:背面有試題

參考用

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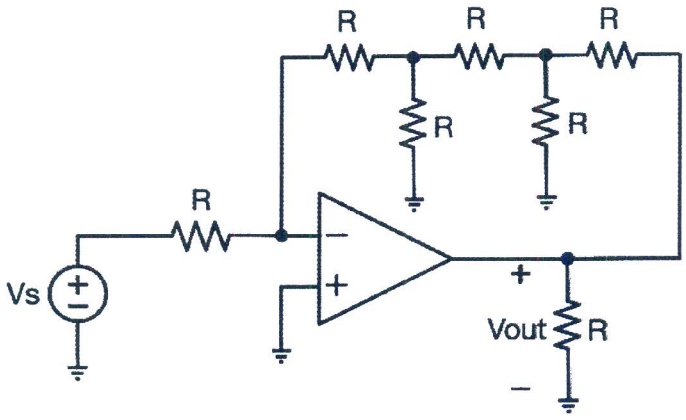
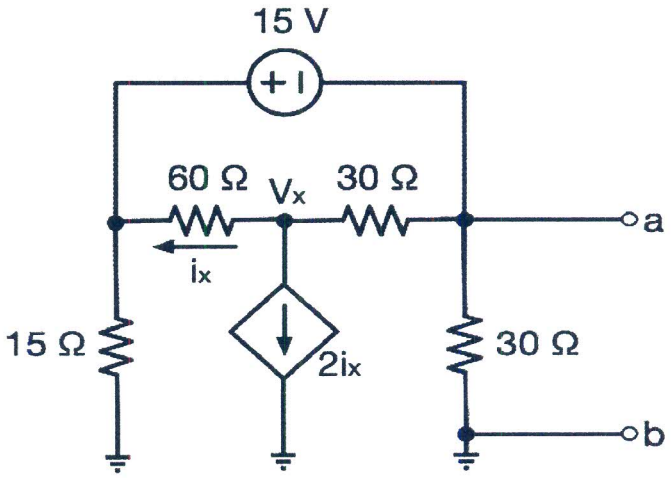
※請在答案卷內作答

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 Vout = $A(V^+ - V^-)$. All of the resistors have the same resistance R. Find the voltage gain Vout/Vs. (10%)



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

參考用

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※請在答案卷內作答

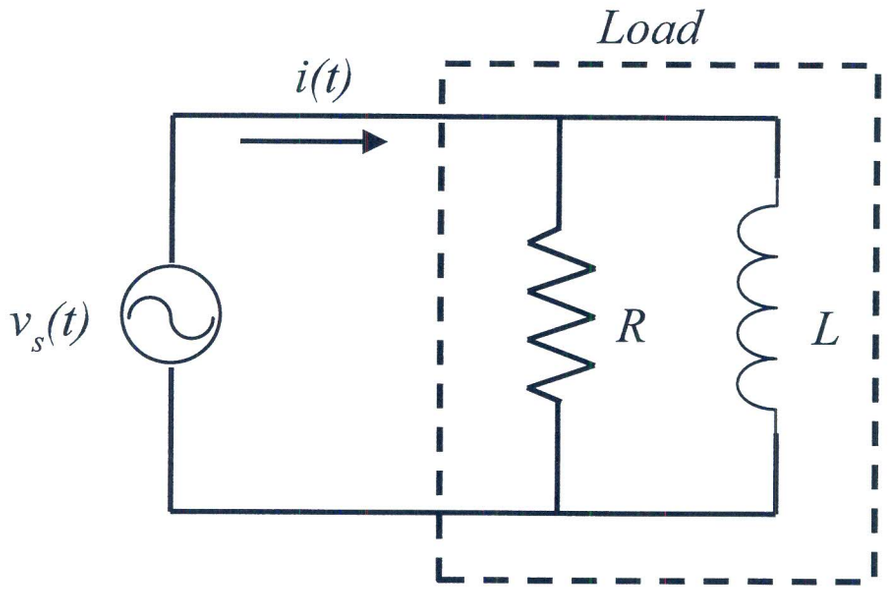
6. The load consisting of a resistor and an inductor in the given circuit is connected to an AC voltage source $v_s(t)=141\cos(377t)$, and it consumes 5kW with a lagging power factor of 0.8.

(a) Calculate the current $i(t)$ consumed by this load (5%).

(b) Calculate the values of R and L (5%).

(c) 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%).

(d) Please discuss the advantage or disadvantage of raising the load power factor from 0.8 to 1.0(5%).



注意：背面有試題

參考用

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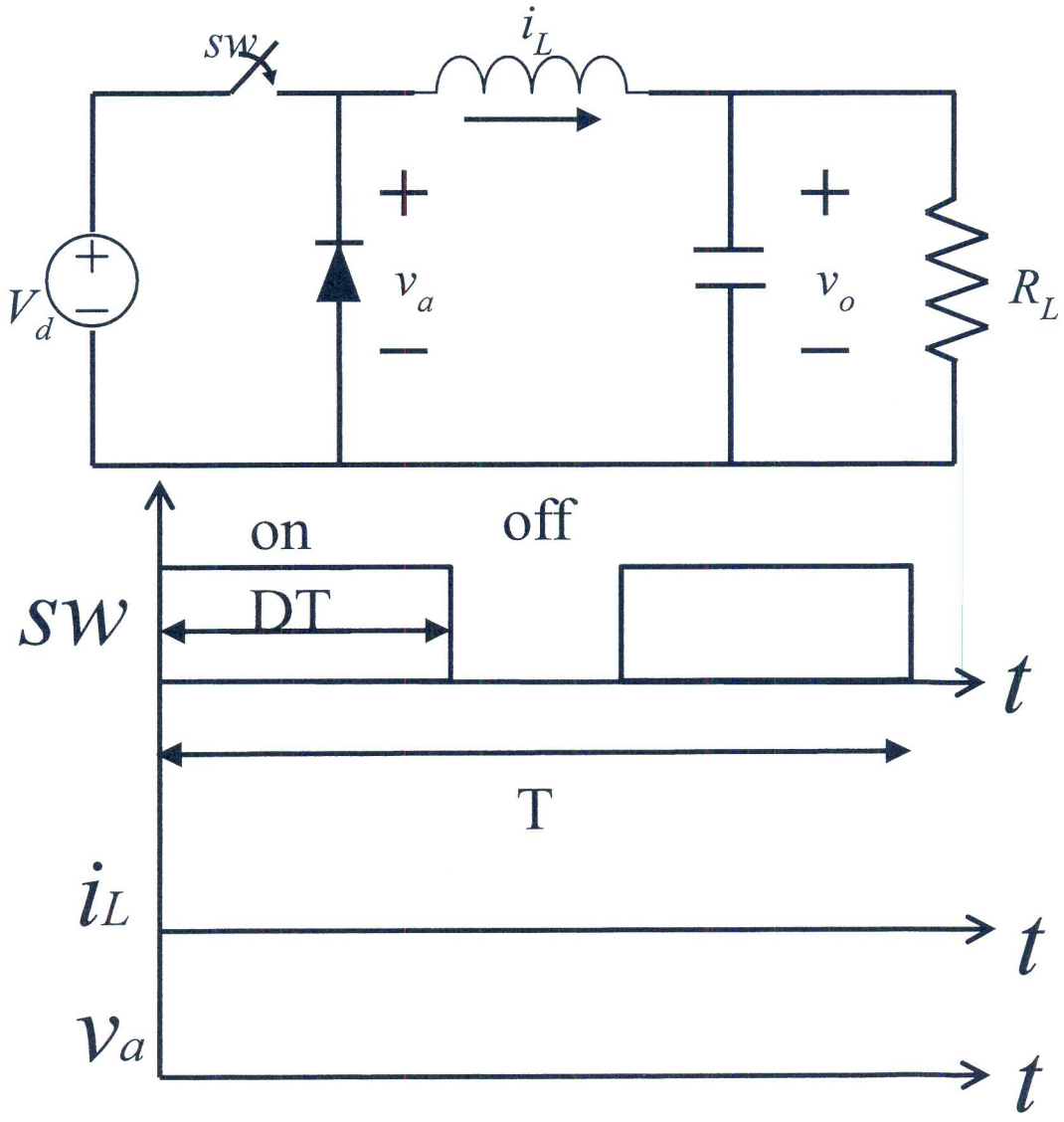
7. The circuit diagram of a step-down converter is as given. The input voltage V_d is 12 VDC, the average output voltage V_o is 5VDC, and the load resistor R_L is 500ohm. The switching frequency of the switch is 25kHz. Assuming the circuit operates in the continuous conduction mode.

(a) Sketch the waveforms of v_a and i_L(5%).

(b) Calculate the duty ratio D. Please show the circuit analysis of this calculation (5%).

(c) 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%).

(d) 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%).



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