

國立清華大學命題紙

九十三年學年度 電機工程學 系(所) 甲 組碩士班入學考試

科目 電路學 科號 2604 共 4 頁第 1 頁 *請在試卷【答案卷】內作答

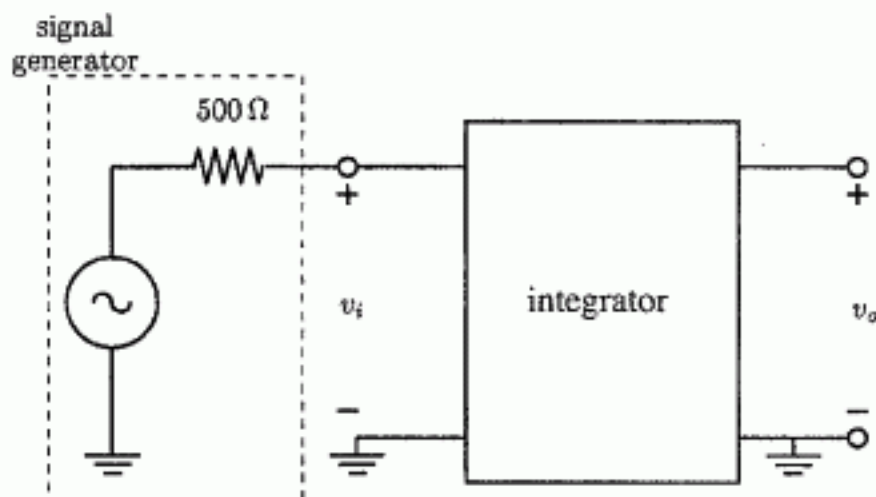
1. You are asked to implement the given integrator:

$$v_o(t) = -100 \int_0^t v_i(\tau) d\tau$$

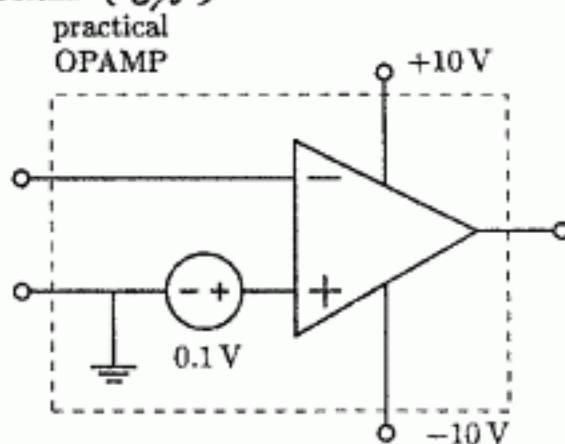
where v_i and v_o are the input and output respectively, using the following available components:

- OPAMP (1 piece);
- Resistors: 1 k Ω ; 10 k Ω ; 100 k Ω (1 piece each).
- Capacitors: 1 μ F; 10 μ F; 100 μ F (1 piece each).

Assuming the input signal is provided by a signal generator which has an output resistance of 500 Ω as illustrated.



- (a) Sketch your circuit implementation. Implementation with less components and higher accuracy receives better grades. (6%)
- (b) Sketch the Bode plot (magnitude and phase) of your design. Please indicate the slope of the curve and the point of transition clearly. (5%)
- (c) Assuming the OPAMP is not ideal, and it has an offset voltage of 0.1 V at the positive input terminal as illustrated. What will happen to this integrator circuit? Please Modify your circuit design to address this problem. (6%)

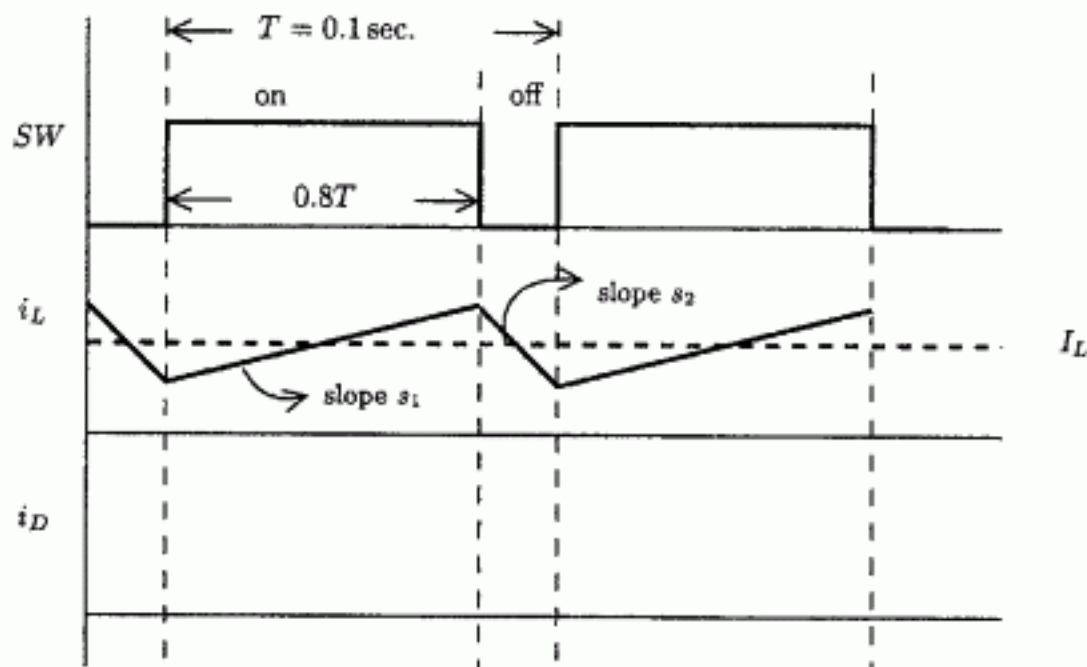
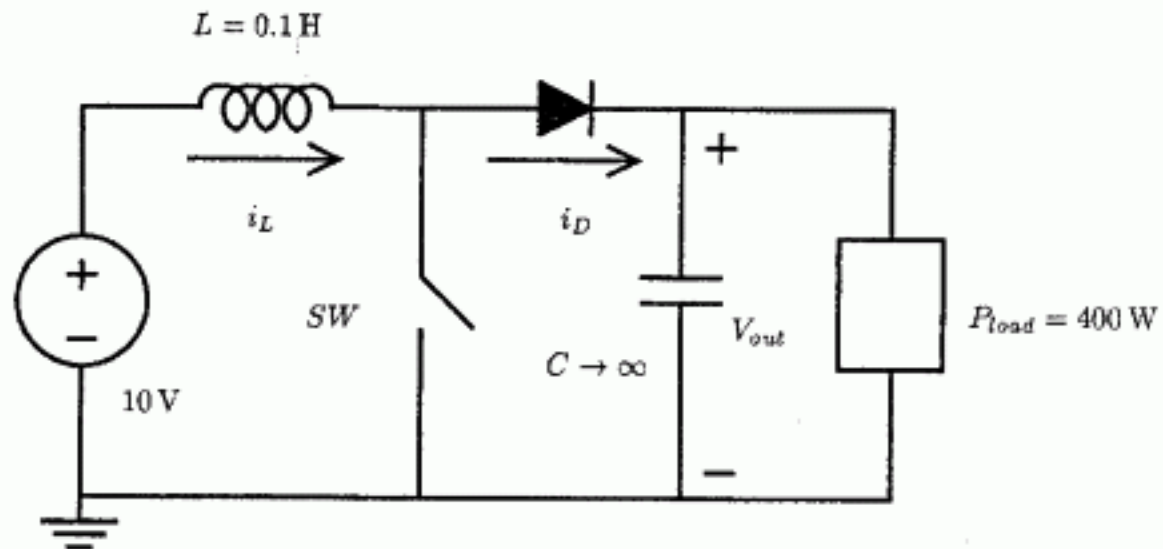


國立清華大學命題紙

九十三年學年度 電機工程學 系(所) 甲 組碩士班入學考試

科目 電路學 科號 2604 共 4 頁第 2 頁 *請在試卷【答案卷】內作答

2. For the given circuit, $L = 0.1 \text{ H}$, $C \rightarrow \infty$, and all the circuit components, including the switch SW and the diode, are ideal and lossless. The load consumes 400 W of power. The switch SW turns on and off alternatively with a period of $T = 0.1 \text{ sec.}$. The circuit has already reached steady-state, so the inductor current waveform is repetitive for every cycle as illustrated. The output voltage V_{out} is considered as constant because it is supported by an extremely large capacitor.



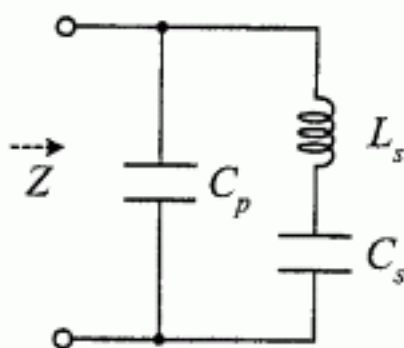
- (a) Derive the slope s_1 and s_2 of the inductor current i_L , and the load voltage V_{out} . (6%)
 (b) Find the average current I_L of the inductor, and the maximum and minimum value of i_L . (6%)
 (c) Sketch the diode current i_D and calculate the average value of i_D . (6%)

國立清華大學命題紙

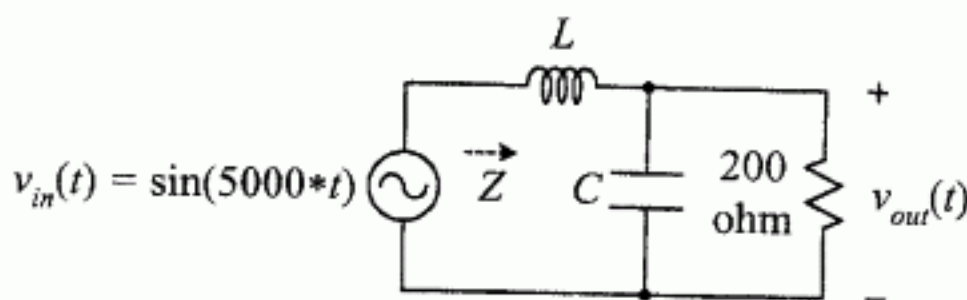
九十三年學年度 電機工程學 系(所) 甲 組碩士班入學考試

科目 電路學 科號 2604 共 4 頁第 3 頁 *請在試卷【答案卷】內作答

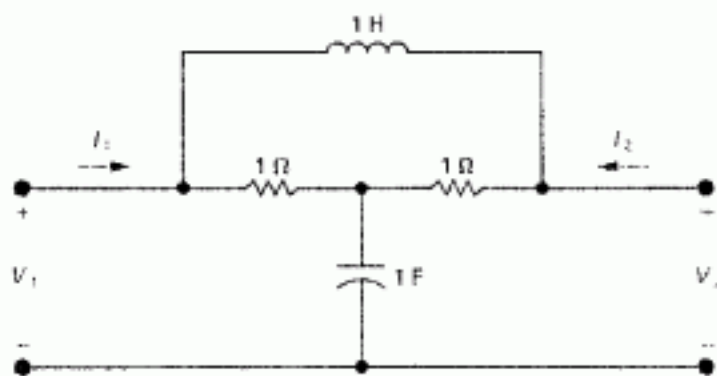
3. Please find all the frequencies when the equivalent impedance Z of the following circuit is zero or infinite. (Use C_p , C_s , and L_s to represent these frequencies) (10%)



4. As shown in the following figure, a RLC circuit is designed so that the equivalent impedance Z is 50 ohm when the angular frequency is 5000.
- (a) Please find the values of L and C . (10%)
- (b) Please calculate $v_{out}(t)$. (10%)



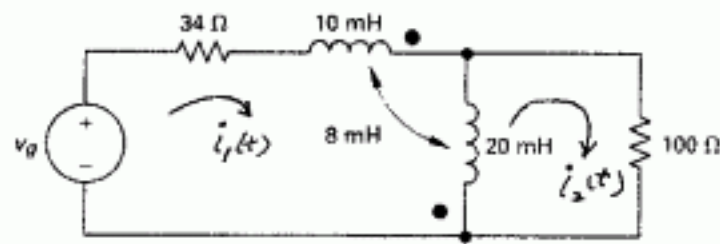
5. Find the s-domain expressions for the Y-parameters of the following two-port circuit. (10%)



九十三年學年度 電機工程學 系(所) 甲 組碩士班入學考試

科目 電路學 科號 2604 共 4 頁第 4 頁 *請在試卷【答案卷】內作答

6. (a) Transform the following time domain circuit into the frequency domain circuit given that the voltage source is equal to $660 \cos 5000t$ volts. (5%)
 (b) Find the corresponding mesh equations in frequency domain. (5%)



7. The variable resistor in the following circuit is adjusted for maximum power transfer R_o .
 (a) Find the value of R_o . (5%)
 (b) Find the maximum power that can be delivered to R_o . (10%)

