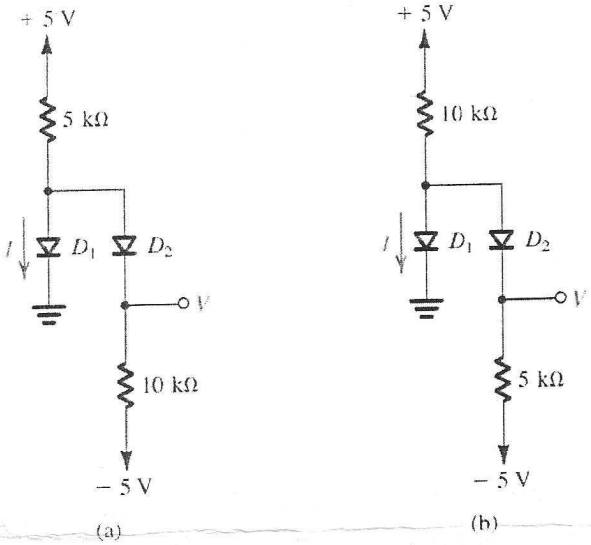
Microelectronic Circuits I (Midterm)

date: 2009/11/12 (Thur)
time:15:30 ~ 17:20

ps. 試題可帶回，可使用計算機。

1. Assuming a conducting diode has a constant voltage drop of 0.7 V, find the values of the labeled voltages and currents. *(20%)*



2. For the circuits shown in Figure 1, use the constant-voltage-drop diode model (V_D = 0.7 V) in the following questions.
   (1) For Figure (c), plot the circuit transfer characteristic, V_i versus V_o. *(5%)*
   (2) For Figure (d), plot the circuit transfer characteristic, V_i versus V_o. *(15%)*
   (Please label key voltages in your plots.)

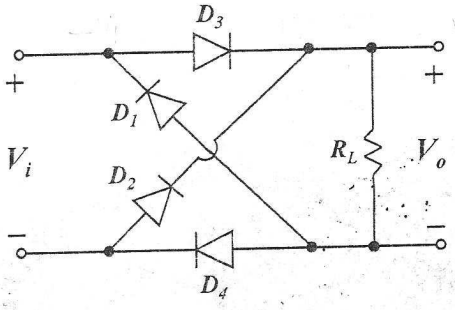


Figure (c)

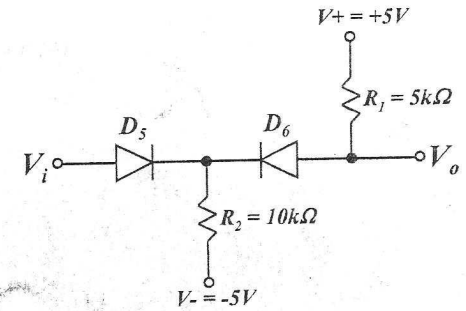


Figure (d)

3. Consider the differential amplifier shown in Figure (e).
   (1) Assume the op amp is ideal. Please derive the closed-loop gain of this amplifier *(4%)*
   (2) Assume the op amp is ideal and resistors are perfect. What is the condition to

obtain the differential amplifier with CMRR→∞ *(1%)*

(3) Assume the op amp has a finite open-loop gain. Please derive the closed-loop gain of this amplifier *(6%)*

(4) Assume R1=1kΩ; R2=10kΩ; R3=2kΩ; and R4=20kΩ and the op amp is ideal. In addition, $V_1(t)=\sin(2\pi t)$ V and $V_2(t)=\sin(2\pi t+\pi)$. Please draw the output voltage waveform for $0 \leqq t \leqq 2$ *(5%)*

(5) Because of the low input resistance, the usage of this differential op amp configuration is limited. Please derive the differential input resistance of the op amp configuration and explain the reason why it becomes a problem in differential amplifier configuration. *(4%)*

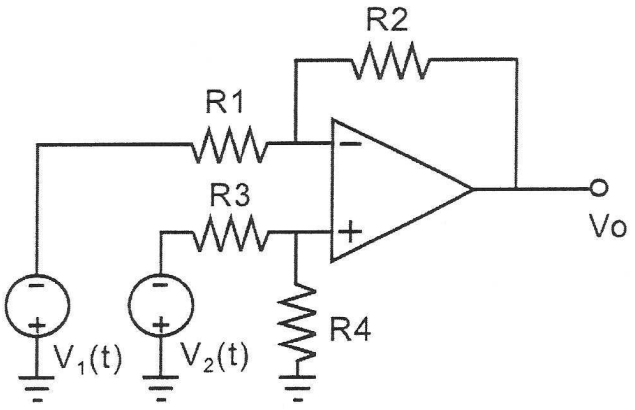


Figure (e)

A.

4. Please design a non-inverting amplifier with an op-amp having finite open-loop gain. The amplifier should meet the following specifications:
(1) closed-looped gain = 5; (2) the gain error = 1%; (3) closed loop bandwidth = 50MHz. Please determine the required open-loop gain and bandwidth of the op-amp. *(10%)*

5. The circuit in the figure is a non-inverting amplifier and the circuit parameters of the opamp are given as:
- ■Low-frequency gain (A_0) = 80 dB
- ■Unity-gain bandwidth (f_t) = 1 MHz
- ■Rated output voltage = ± 15 V
- ■Maximum output current = ± 5 mA
- ■Slew rate = 1 V/μs

(1) Assume R_1 = 1 kΩ and $R_L = \infty$. For an amplifier bandwidth ≥ 10 kHz, find the maximum voltage gain in dB and the value of R_2. *(6%)*

(2) Assume R_1 = 1 kΩ, R_2 = 999 kΩ and $R_L = \infty$. What is the 3-dB bandwidth of the amplifier? *(6%)*

(3) A low-frequency sine-wave is applied to the input of the amplifier with $R_1 = 1$ kΩ, $R_2 = 9$ kΩ and $R_L = 20$ kΩ. Find the maximum input amplitude of the amplifier such that the output waveform is not distorted. *(6%)*

(4) Repeat (3) with $R_L = 2$ kΩ. *(6%)*

(5) For an amplifier with $R_L = \infty$ and $R_1 = \infty$, find the maximum input amplitude of a sine-wave at 50 kHz. *(6%)*