國 立 清 華 大 學 命 題 紙

96 學年度 微機電系統工程研究所（所） 組碩士班入學考試

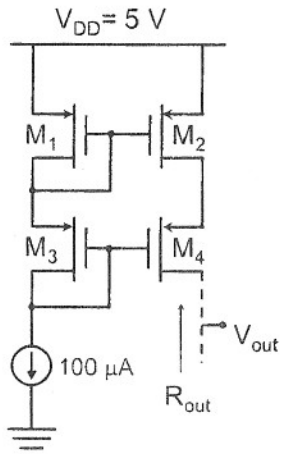
科目 電子學 科目代碼 1906 共 3 頁第 1 頁 *請在【答案卷卡】內作答

1. (15%) For a cascode current source, where $\mu_p C_{ox}$= 100 μA/V^2, $|V_{tp}|$= 0.7 V, λ= 0.05 V^{-1}, and W/L= 50 for all devices:

(a) What is the advantage of using a cascode current source? (5%)

(b) Determine R_{out}. (5%)

(c) Find the maximum V_{out} to keep M_2, M_4 in the saturation region. (5%)

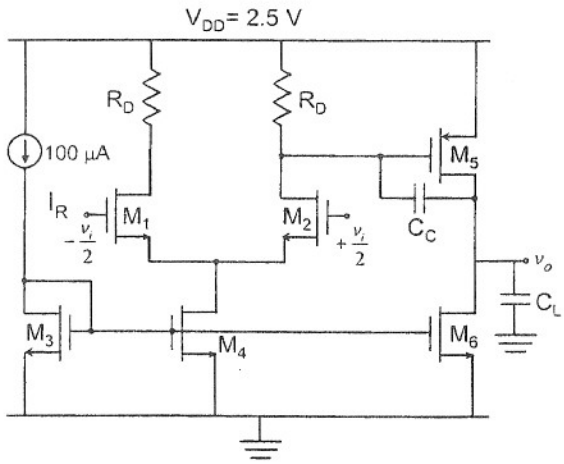


2. (15%) For a two-stage CMOS operational amplifier:

(a) Determine the low-frequency small-signal gain. (5%)

(b) Determine the 3-dB frequency f_H. (5%)

(c) Determine the phase margin. Neglect the impact of the zero. (5%)



NMOS	PMOS
$\mu_n C_{ox}$= 100 μA/V^2	$\mu_p C_{ox}$= 50 μA/V^2
V_t= 0.7 V	$\|V_t\|$= 0.7 V
V_A= 40 V	$\|V_A\|$= 40 V

$(W/L)_1 = (W/L)_2$= 100

$(W/L)_3$= 100, $(W/L)_4$= 200

$(W/L)_5 = (W/L)_6$= 50

R_D= 1 kΩ, C_C= 0.2 pF, and C_L= 0.5 pF

3. (15%) The basic amplifier (before adding feedback) has a low-frequency gain of 10^5, and $f_p = 2\pi \times 10^6$ Hz.

(a) Identify the feedback type of this circuit (5%)

(b) After applying the feedback network, the gain of the circuit drops to 10^3. Estimate the bandwidth of the new circuit. (5%)

(c) Determine R_f if R_s is 10 Ω for a closed-loop gain of 10^3. (5%)

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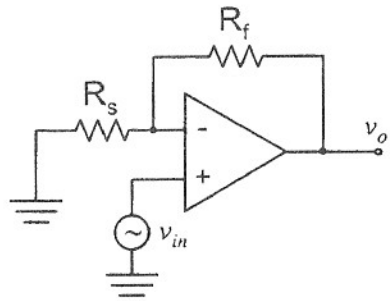
科目 電子學 科目代碼 1906 共 3 頁第 2 頁 *請在【答案卷卡】內作答



4. (5%) Circle the correct descriptions from the following items (multiple choices):

(a) Common-gate amplifier can be used as a voltage buffer.

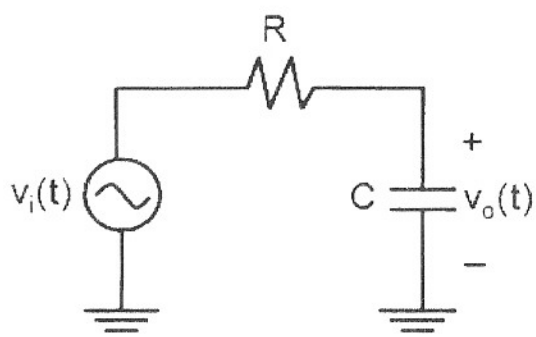
(b) Active-loaded amplifier consumes a larger chip area comparing with the resistive-loaded one.

(c) BJTs have a higher intrinsic gain than MOSFETs.

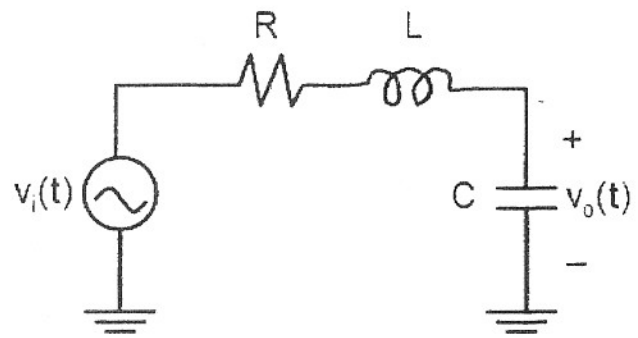
(d) Negative feedback can alter the input/output resistances of an amplifier.

(e) The gate-drain capacitance in a MOSFET mainly origins from the overlap capacitance between the gate oxide layer and the drain diffusion region.

5. (15%) Please plot the frequency responses (magnitude and phase) of $v_o(j\omega)/v_i(j\omega)$ for the two networks below. You can sketch the curves and mark the important magnitudes, phases, and slopes along the frequency axis. Please provide the unit of the frequency in the plots.



(a)



(b)

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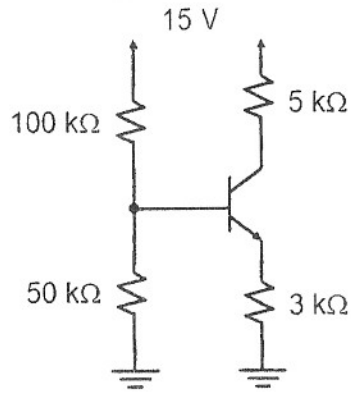
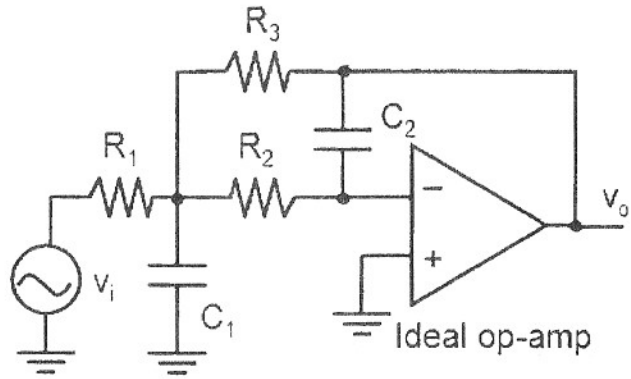
6. (10%) Analyze the circuit below to determine the voltages at all nodes and the currents through all branches. Assume β = 100.



7. (12%) Derive the transfer function $v_o(s)/v_i(s)$ for the circuit below.



8. (13%) The schematic as shown in a Wien-bridge oscillator. Please calculate the ratio of R_1/R_2 such that the oscillation can start to happen, and indicate the oscillation frequency.