

國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：電子學【醫科所碩士班選考】

題號：428007

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題） 共 2 頁第 1 頁

總分 100 分，請在答案紙上作答。

1. (18%) The parameters of the transistor in the circuit of Figure 1 are $V_{TP} = -1.8 \text{ V}$ and $k_p = 2 \text{ mA/V}^2$. Design the circuit such that $I_D = 4 \text{ mA}$, $V_{SD} = 6 \text{ V}$, and $R_{in} = 80 \text{ k}\Omega$.

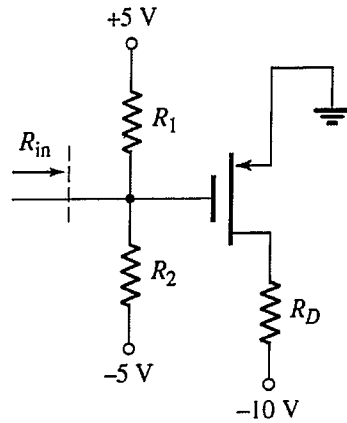


Figure 1

2. (24%) The transistor parameters for the circuit in Figure 2 are $\beta = 200$, $V_A = 50 \text{ V}$, $V_{EB}(\text{on}) = 0.7 \text{ V}$, and $V_T = 0.026 \text{ V}$.
- (1) Find the voltage gain (A_v) of this amplifier. (8%)
 - (2) Find the output resistance R_o . (8%)
 - (3) Given the signal source $v_s(t) = 4 \sin \omega t$ in unit of Volt, determine $i_o(t)$ and $v_o(t)$. (8%)

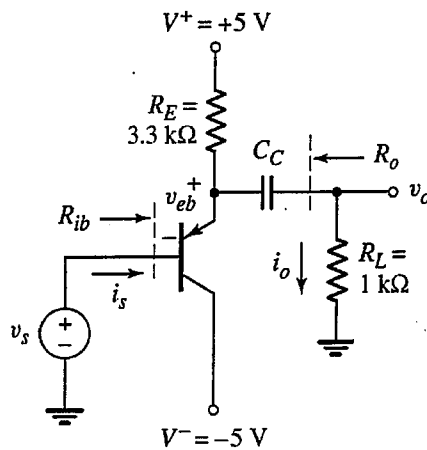


Figure 2

3. (16%) Two inverting operational amplifiers are connected in cascade (Figure 3). For an input voltage (v_I) of 5 mV with $R_1 = 1 \text{ k}\Omega$, $R_2 = 10 \text{ k}\Omega$, $R_3 = 50 \text{ k}\Omega$, and $R_4 = 1 \text{ M}\Omega$, determine
- (1) v_{O1} and v_O . (8%)
 - (2) the current into or out of the output terminal of each op-amp. (8%)

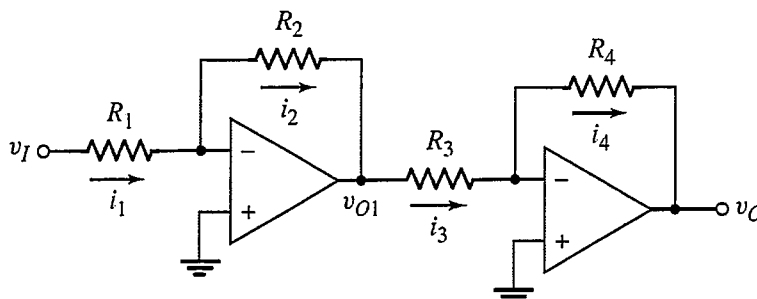


Figure 3

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4. (20%) Figure 4 shows a differential amplifier consisting of two stages. The common-mode rejection ratio (CMRR) of stage 2 is 60 dB.
- (1) For $R_1 = 2 \text{ k}\Omega$ and $R_2 = 5 \text{ k}\Omega$, calculate the CMRR of stage 1. Then calculate the total CMRR provided by both stages. (10%)
 - (2) The ideal CMRR of stage 2 is infinitely large, but in practice it's not. For example, it's 60 dB in this case. Please explain the possible reason. (4%)
 - (3) As part of an amplifier, what is the main advantage(s) of each stage? (6%)

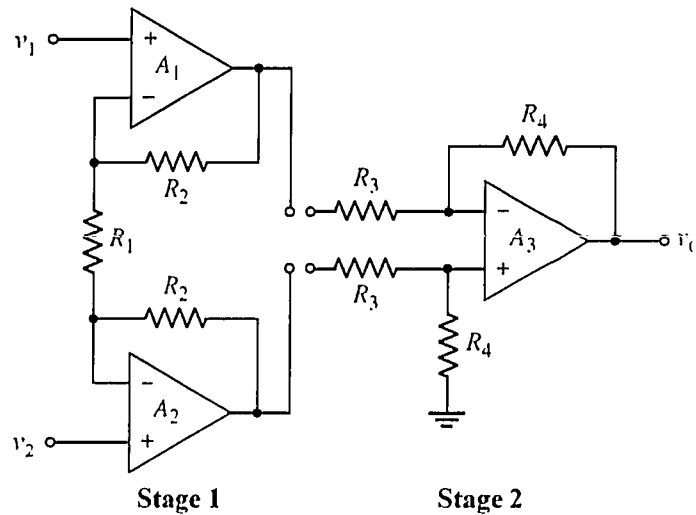


Figure 4

5. (22%) The non-inverting amplifier in Figure 5 consists of a basic op amplifier with an input resistance of $R_i = \infty$, an output resistance of $R_o = 0 \Omega$, and a finite open-loop voltage gain of A .
- (1) Express the closed-loop voltage gain (A_f) of this feedback circuit in the form of

$$A_f = \frac{v_o}{v_s} = \frac{A}{1 + \beta A}$$

What is the expression of β ? (8%)

- (2) Given that $A = 10^5$ and $A_f = 20$, what is the corresponding R_2/R_1 ? (6%)
- (3) If A increases by 10 percents, what is the percent change in A_f ? (8%)

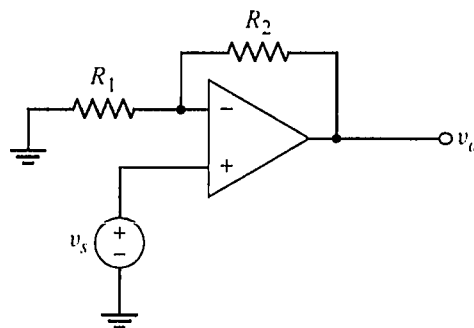


Figure 5