

科目：電子學

適用：電機系

編號：341.

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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1. Answer the following questions:

- (a) What is Early effect in a bipolar junction transistor? Please describe the reason that causes this effect (5%)
- (b) Describe the effect of channel length modulation on the $i_{DS}-V_{DS}$ characteristics of MOSFET? (5%)
- (c) Explain the difference(s) between depletion capacitance and diffusion capacitance in a pn junction. (5%)

2. If all the OP amps are ideal in the circuit shown in Fig. 1. Please find the input impedance Z_i of the circuit (in terms of complex frequency variable $s = j\omega$). (10%)

3. For the cascade amplifier circuit with constant-current source load shown in Fig. 2, assume that all the transistors are identical and V_{G2} , V_{G3} , and V_{G4} are dc bias voltages. Please find the output resistance R_o and voltage gain $A_v = v_o/v_i$. (15%)

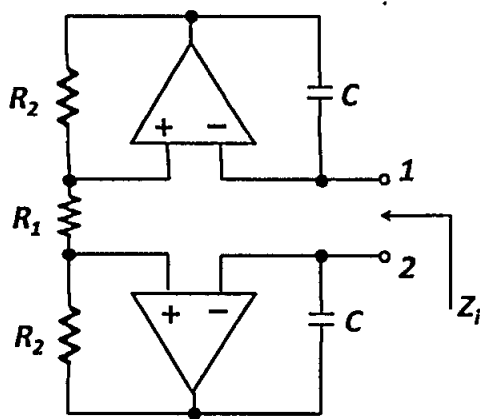


Fig. 1

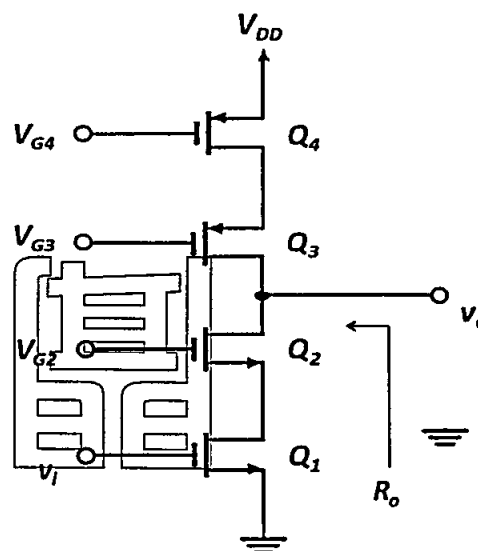


Fig. 2

4. Find the expression for the short-circuited current gain β for CE (common-emitter) transistor under high frequency in terms of complex frequency variable $s = j\omega$. Also determine the corner (3dB) frequency ω_β of β . (15%)
5. The CC-CE amplifier shown below (Fig. 3) has a bias current $I_1 = I_2 = 250 \mu A$ and identical transistors with $\beta = 100$. Find the input resistance R_{in} and the overall voltage gain obtained when the amplifier is fed with a signal source having $R_{sig} = 1 k\Omega$ and loaded with a resistance $R_L = 5 k\Omega$. (Ignore the output resistance r_o). (15%)
6. For the circuit given in Fig. 4, if the transistor has $V_t = 1 V$, $k_n = \mu_n C_{ox}(W/L) = 0.5 mA/V^2$, and $V_A = \infty$, please find the voltage gain v_o/v_i and the input resistance R_{in} . (15%)
7. If all the transistors in the circuit given in Fig. 5 are matched and have a current gain β . Please find I_{O1} and I_{O2} in terms of I_{REF} and β . (Ignore the channel length modulation effect). (15%)

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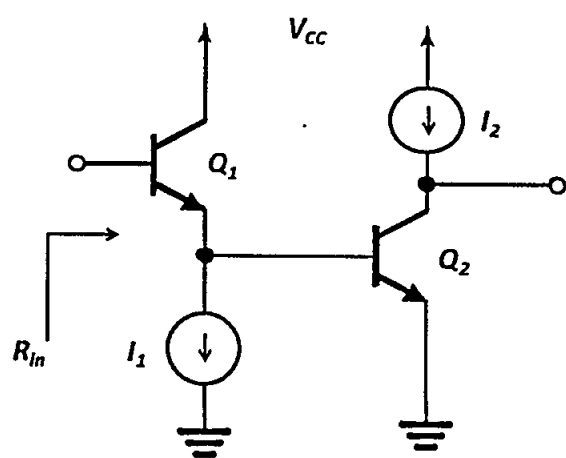


Fig. 3

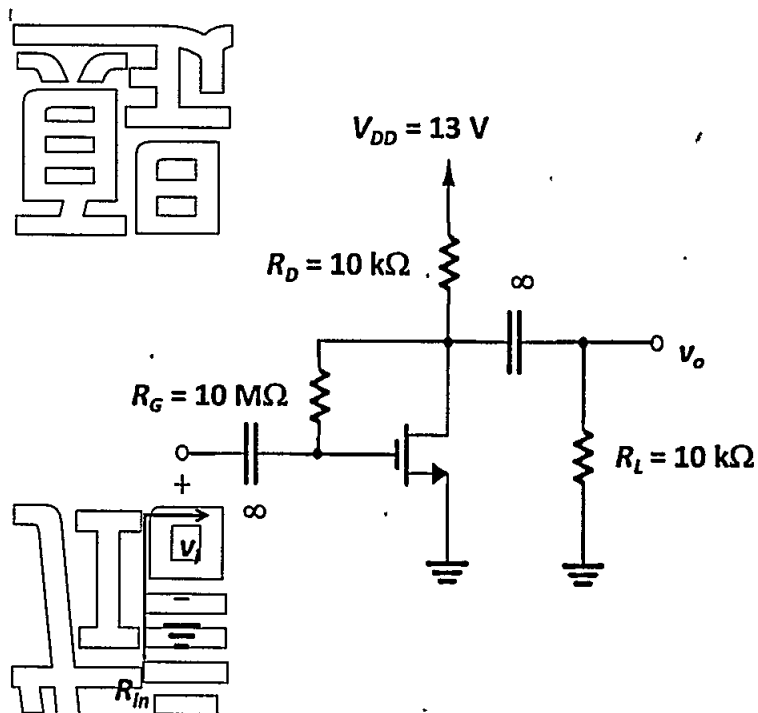


Fig. 4

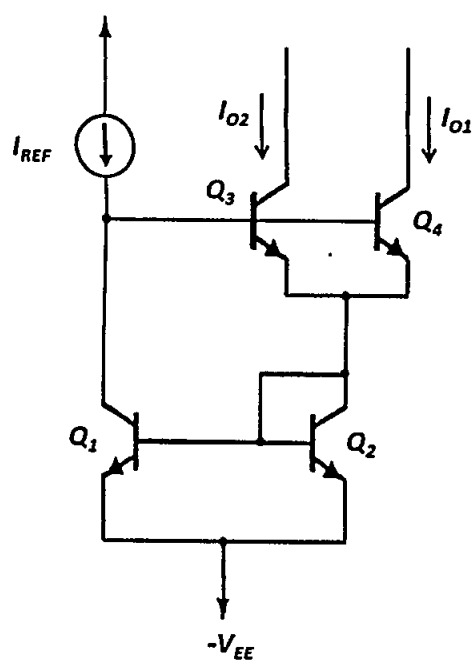


Fig. 5