國立成功大學

115學年度碩士班招生考試試題

編　號：131、134

系　所：電機工程學系
通訊工程研究所

科　目：電子學

日　期：0203

節　次：第 1 節

注　意：1.可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

1. Design the circuit in Fig. 1 to obtain a dc voltage of +0.1 V at each of the drains of Q_1 and Q_2 when $V_{G1}=V_{G2}=0$ V. Operate all transistors at $V_{GS}-V_{tn}=V_{OV}=0.15$ V and assume that for the process technology in which the circuit is fabricated, $V_{tn}=0.4$ V and $\mu_n C_{ox}=400\ \mu A/V^2$. Neglect channel-length modulation.
   (a) Determine the values of R and R_D (10%)
   (b) Find the W/L ratios of Q_1, Q_2, Q_3, and Q_4 (20%)
   (c) What is the input common-mode voltage range for your design? (10%)

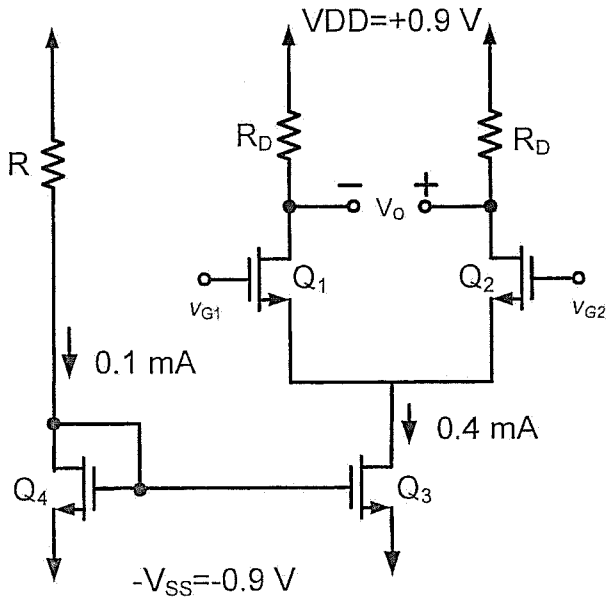

Fig. 1

2. Consider the circuit of Fig. 2 for the case: I = 200 μA and $V_{GS}-V_{tn}=V_{OV}=0.2$ V, $R_{sig}=100$ kΩ, $R_D=50$ KΩ, $C_{gs}=4$ pF, and $C_{gd}=0.5$ pF.
   (a) Find the dc gain (10%)
   (b) Find the high-frequency poles (f_{p1} and f_{p2}) (10%)
   (c) Find the estimated -3 dB frequency (f_H) (10%)

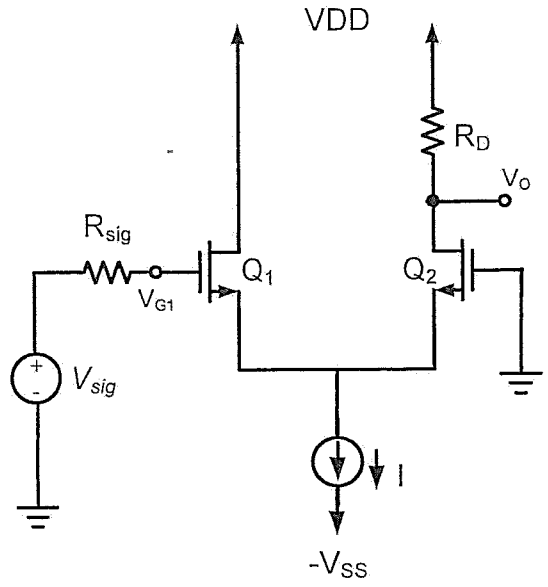

Fig. 2

3. The feedback current amplifier in Fig. 3 can be thought of as a "super" common gate (CG) transistor. Note that rather than connecting the gate of Q_2 to the signal ground, an amplifier is placed between the source and gate. g_{m2} = 1 mA/V and r_{o2} = 50 kΩ are the transconductance and output resistance of transistor Q_2, respectively.

   (a) If μ is infinite, what is the signal voltage at the input terminal (V_{in}) ? What is the input resistance (R_{in})? What is the current gain I_o/I_i? (3%)

   (b) For finite μ=1000, but assuming that the input resistance (R_{id}) of the amplifier is infinite, find the values and derive expressions for A, R_i, and R_o of the open-loop gain (A) circuit. (9%)

   (c) What is the value of the feedback factor β? (3%)

   (d) Find Aβ and A_f. If μ is infinite, what is the value of A_f. (9%)

   (e) Find R_{in} and R_{out}. (6%)

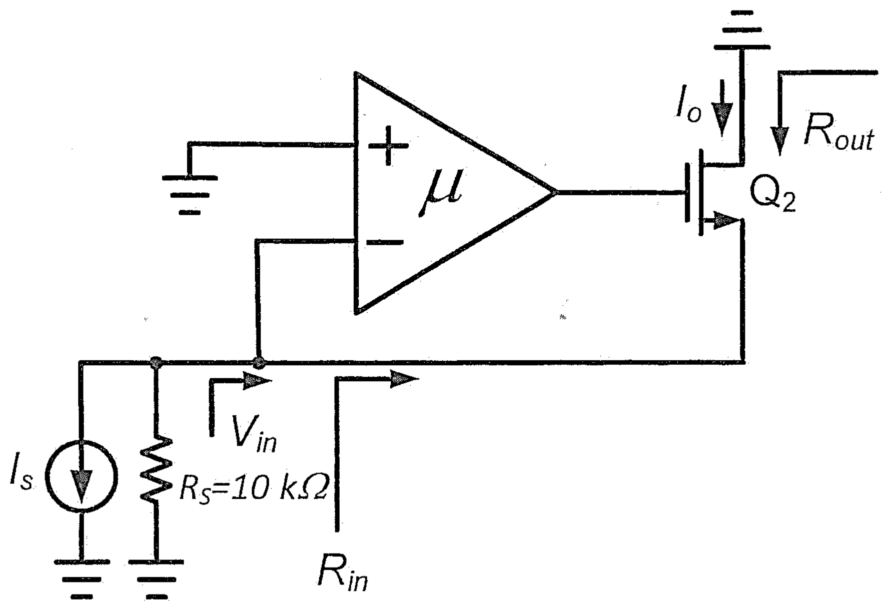

Fig. 3