國立彰化師範大學 100 學年度碩士班招生考試試題

系所：光電科技研究所　　科目：電子學

☆☆請在答案紙上作答☆☆　　

1. Consider the stage shown in Fig. 1, where I_1 defines the bias current of M_1 and C_1 is very large. (a) If $\lambda = 0$, $I_1 = 1$ mA, $\mu_n C_{ox} = 0.2$ mA/V^2, and $V_{TH}=0.4$V, what is the maximum allowable value of R_D? (b) With the value found in (a), determine W/L to obtain a voltage gain of 5. (20%)
2. Assume $V_A = \infty$. (a) Construct the small-signal model of the circuit shown in Fig. 2. (b) Determine the output and input impedances of the circuit shown in Fig. 2. (c) Determine the voltage gain of the circuit shown in Fig. 2. (20%)
3. In the circuit of Fig. 3, determine the value of R_1 such that this resistor carries 0.5 mA. Assume $I_S = 5 \times 10^{-16}$ A for each diode. (10%)
4. A discrete common-source MOSFET amplifier utilizing a drain-to-gate resistance for biasing purpose is shown in Fig. 4. The transistor has $V_t=1$ V, $K_n'(W/L)=0.4$ mA/V^2,and $V_A=100$ V. Please calculate (a) the small-signal voltage gain A_v, (b) the input resistance R_{in}, (c)output resistance R_o, and (d) the largest allowable input signal v_i. (20%)
5. An active-loaded MOS differential amplifier of the type shown in Fig. 5 is specified as follows: $(W/L)_n=250$, $(W/L)_p=500$, $\mu_n C_{ox}=2\mu_p C_{ox}=0.5$ mA/V^2, $V_{An}=|V_{Ap}|=100$V, $I_{SS}=0.5$ mA, $R_{ss}=25$ kΩ. Calculate the (a) short-circuit transconductance G_m, (b) output resistance R_o,(c) differential gain A_d, (d) common mode gain $|A_{cm}|$, and (e) CMRR. (20%)
6. A given N-output current mirror circuit is shown in Fig. 6. All the transistors are matched, equal size, and have finite β and ignore the effect of finite output resistance. (a) Derive the relation of I_1, I_2,…, I_N with I_{REF}. (b) For the β=150, find the number of N for an error (I_N-I_{REF}/I_{REF}) not exceeding 5%.(10%)

(Ref: Microelectronic Circuits 6th by Sedra and Smith, Fundamentals of microelectronics by Behzad Razavi)

Fig.1

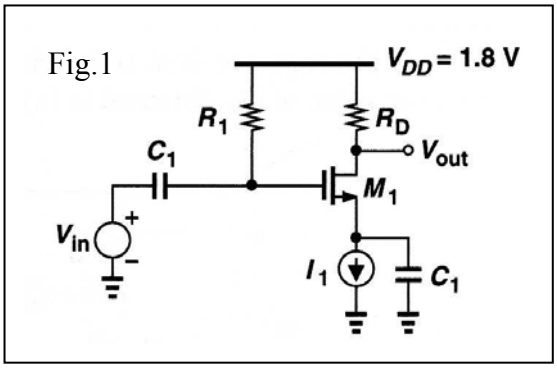

Fig.2

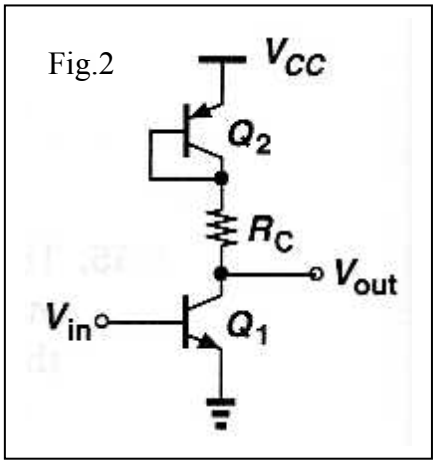

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Fig.3

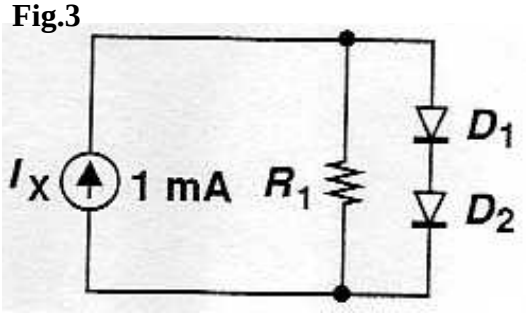

Fig.4

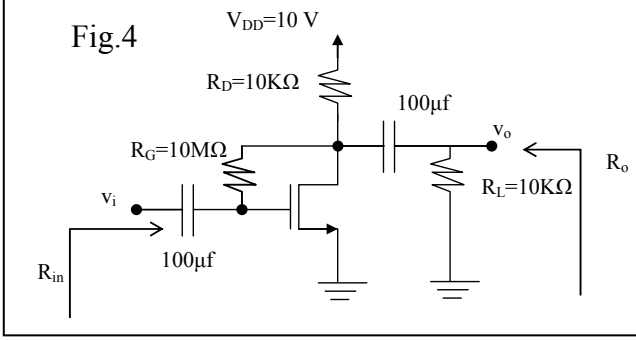

Fig.5

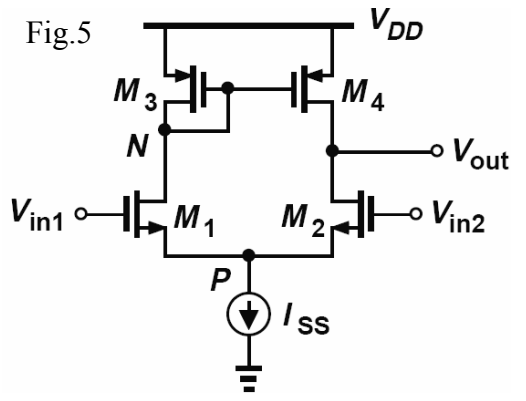

Fig.6