元智大學 103 學年度研究所 **碩士班** 招生試題卷

系(所)別：通訊工程學系碩士班　組別：微波組　科目：電子學　用紙第 / 頁共 2 頁

●不可使用電子計算機

1. Consider the circuit shown in Fig.1. If the input is given by $V_{in} = V_o \sin(\omega t)$, plot the output waveform as a function of time. Assume an ideal diode model (on-off model). 15%

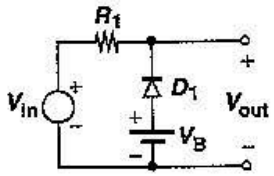

Fig.1

2. The circuit shown in Fig.2 is designed for a collector current I_C of $1mA$. Assume $\beta+1 \sim \beta = 100$, $V_A = \infty$ and $I_s = 1 \times 10^{-16} A$. (a) Determine the required value of R_B. (b) Calculate V_{CE}, V_{BE} and I_B. (c) Calculate the small signal transconductance g_m. (Hint: ln(10) = 2.3025 , V_T = 26 mV) 18% ((a) 6% (b) 6% (c) 6%)

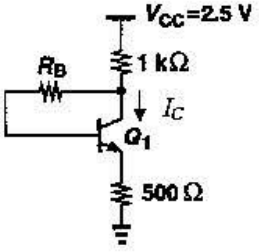

Fig.2

3. Consider the channel-length modulation of MOS transistors. Determine (a) the input impedance, (b) the output impedance, and (c) the voltage gain of the stage shown in Fig.3. g_{m1}, g_{m2} are the transconductances of M_1 and M_2. r_{o1}, r_{o2} are the channel-length modulation impedance of M_1 and M_2. Neglect the capacitance inside these transistors. 17% ((a) 6% (b) 6% (c) 5%)

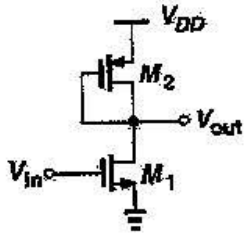

Fig.3

4. The NMOS transistor in the discrete common-source amplifier shown in Fig. 4 is biased to have the transconductance g_m and the channel-length modulation impedance r_o. (20%)
   (a) Find the expression of the mid-band voltage gain $A_M = V_o/V_{sig}$. (5%)
   (b) Find the expressions of the three low frequency poles corresponding to the three capacitors C_{C1}, C_{C2}, and C_S, respectively. (9%)
   (c) Find the high frequency corner frequency f_H in terms of C_{gs} and C_{gd} for the NMOS FET. (6%)

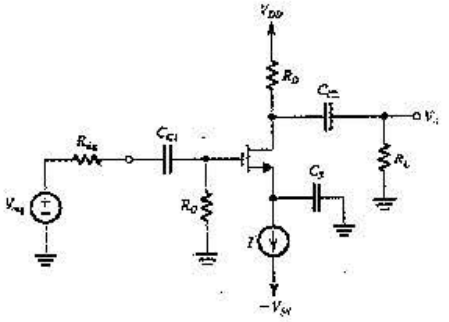

Fig. 4

5. The active-loaded MOS differential amplifier shown in Fig. 5, all transistors have the same kW/L and $|V_A|$. Find the differential gain $A_d = v_o/v_{id}$ and the output resistance. (10%)

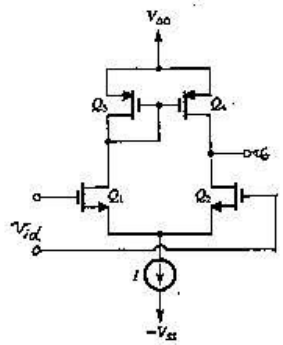

Fig. 5

6. A shunt-shunt feedback amplifier is designed with an operational amplifier as shown in Fig. 6, where the operational amplifier has a finite open-loop gain μ with infinite input impedance and zero output impedance. (20%)
   (a) Find the basic amplifier gain A (without feedback effect) and the feedback factor β. (8%)
   (b) Find the feedback gain A_f, the input impedance R_{if} and the output impedance R_{of}. (12%)

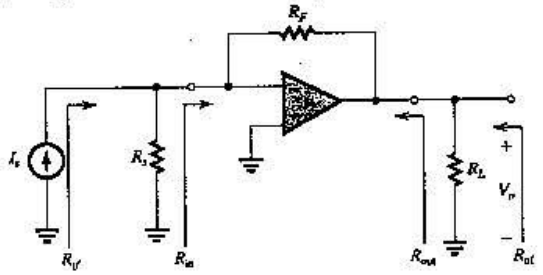

Fig. 6