淡江大學八十七學年度日間部轉學生入學考試試題

系別：電機工程學系三年級　　　科目：電子學

1. For the diode-connected enhancement MOSFET of Fig.1, ① find an expression for its (20%) incremental resistance γ at $v = 2V_t$. Neglect the small effect of r_0. ② Evaluate γ for the case $V_t = 1V$, $\mu_n C_{ox} = 20 \mu A/V^2$, $W = 6 \mu m$ and $L = 30 \mu m$.

Fig.1
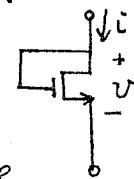
2. In the circuit shown in Fig.2, I is a dc current and v_s is a ~~sinusoidal~~ (20%) sinusoidal signal. ① Use the diode small signal model to show that the signal component of the output signal voltage $v_o = ?$ (in terms of V_T, R_S, I, v_s assuming i-V of diode is $i \simeq I_s e^{v/V_T}$, I_s : saturation current) ② If $v_s = 10 mV$, $I = 1 mA$, $R_s = 1 K\Omega$, Find $v_o = ?$ ($V_T = 0.6V$)
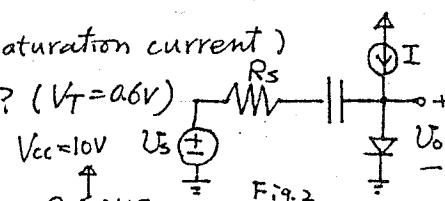
Fig.2

3. Determine the voltage gain of Fig.3, $\frac{v_o}{v_i} = ?$ (20%) (v_o, v_i are small signal)

Fig.3　$\beta = 100$
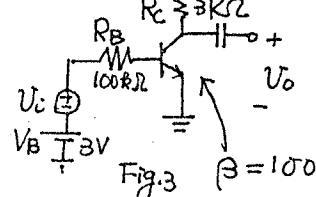
4. Determine the circuit shown in Fig.4, $V_{GS} = ?$　$I_D = ?$ (20%)
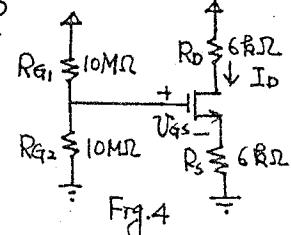
Fig.4

5. Consider the current mirror circuit of Fig.5, with $V_{SS} = -5V$, $I_{REF} = 10 \mu A$, (20%) $V_T = 1V$, $\mu_n C_{ox} = 20 \mu A/V^2$, $V_A = 20V$, $L = 10 \mu m$, $W = 40 \mu m$ for Q_1, Q_2, Q_3, Q_4 Find ① the output resistance ② the lowest allowable output voltage.

Fig.5