(1) Please explain the following keywords:
   (a) Forward active (for BJT operation) (5%)
   (b) Pinch-off (for FET) (5%)
   (c) LED (5%)
   (d) ECL (5%)
   (e) Early effect (for BJT) (5%)
   (f) EEPROM (5%)
   (g) Body effect (for MOS) (5%)
   (h) Slew rate (5%)

(2) Consider the circuit shown in Figure 1. Assume each diode cut-in voltage is V_γ = 0.6 V. Find R_1, R_2, R_3 such that I_{D1}= 0.2 mA, I_{D2}= 0.3 mA, I_{D3}= 0.5 mA. (10%)

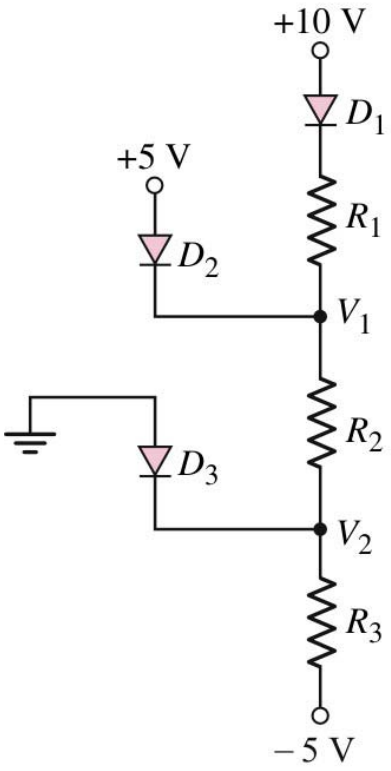

Figure 1

(3) Find the input resistance R_i for the circuits shown in Figure 2. The parameters of each transistor are $\beta = 100$ and $I_{CQ} = 0.26\text{mA}$. (10%) ($V_T = 26\text{mV}$)

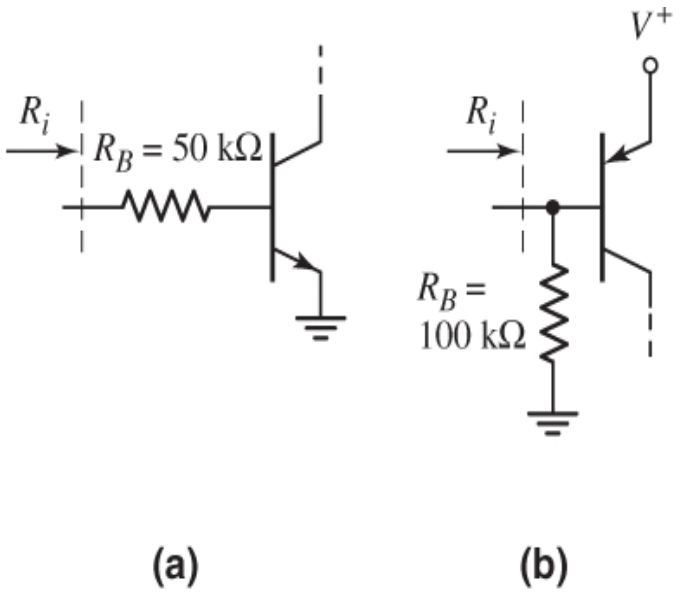

Figure 2

(4) What is the logic function implement by the circuit in Figure 3. (10%)

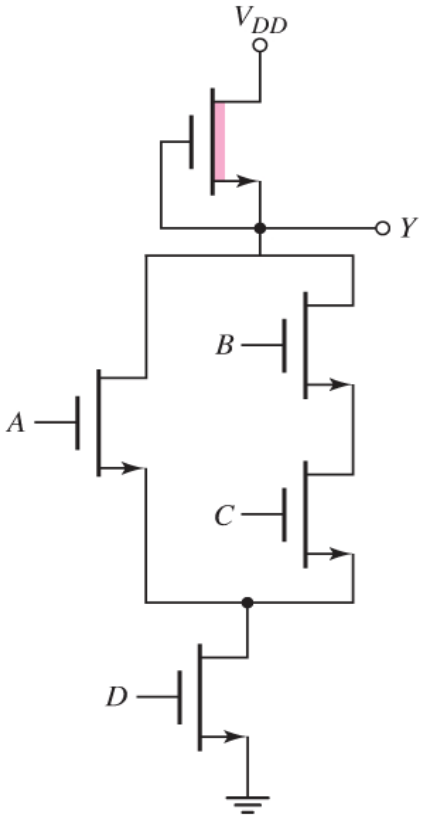

Figure 3

(5) Find the unity-gain frequency f_T of an FET. The parameters of an n-channel MOSFET are K_n = 3.14 mA/V^2, V_{TN} = 0.4 V, C_{gd} = 10 fF, and C_{gs} = 30 fF. Assume the transistor is biased at V_{GS} = 0.8 V. (where $K_n = \frac{W\mu_n C_{ox}}{2L}$) (10%)

(6) Consider the circuit shown in Figure 4. Please show that the close-loop transresistance gain is given by (10%)

$$A_{Mf} = \frac{v_o}{i_i} = \frac{+\left(A_M + \frac{r_\pi R_C}{R_F}\right)}{\left(1+\frac{R_C}{R_F}\right)\left(1+\frac{r_\pi}{R_F}\right) - \frac{1}{R_F}\left(A_M + \frac{r_\pi R_C}{R_F}\right)}$$

where $A_M = -g_m r_\pi R_C = -h_{fe} R_C$

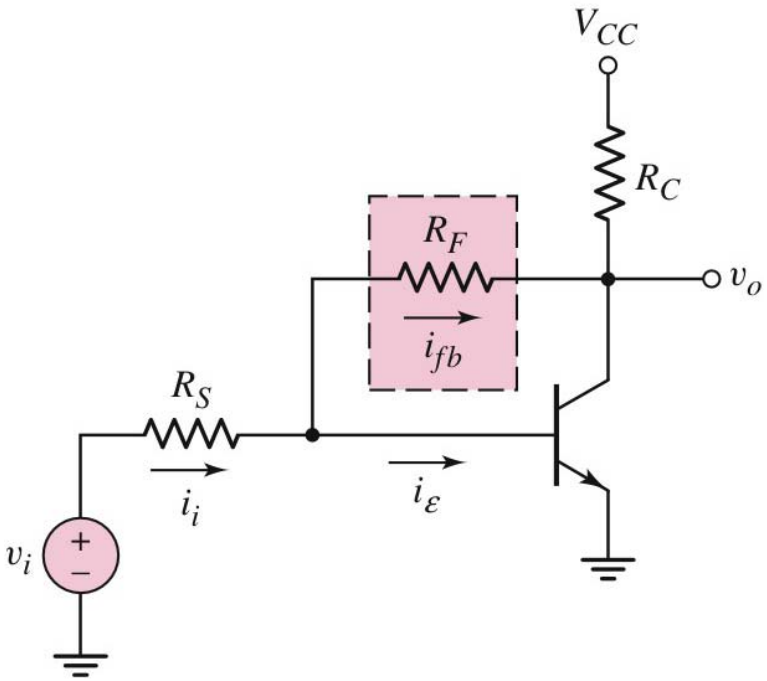

Figure 4

(7) For the amplifier in Figure 5, determine (a) the closed-loop voltage gain $A_v = v_o/v_i$, (b) v_O for $v_I = 0.2\,\text{V}$. (10%)

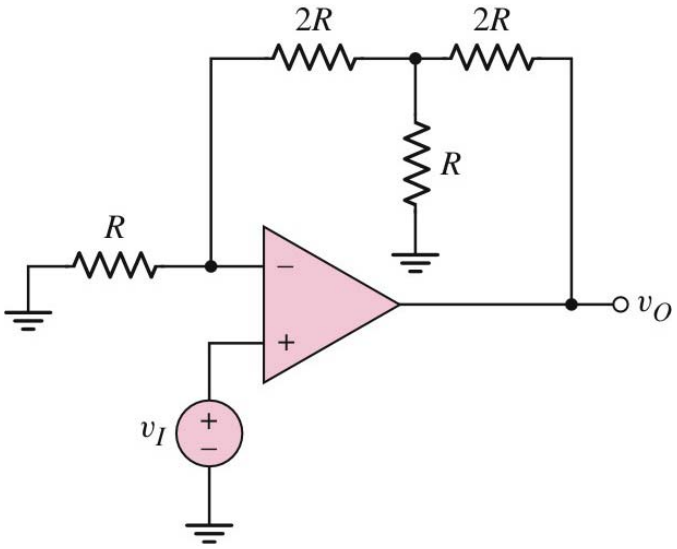

Figure 5