國立雲林科技大學
101 學年度碩士班暨碩士在職專班招生考試試題

系所：電機系
科目：電子學(1)

1. Figure 1 shows a typical output characteristic of an *npn* bipolar transistor biased at a given base current. Two operating points (Q_A, Q_B) are chosen.
   (a) Please compare the magnitude of output resistance (r_{OA} vs. r_{OB}) for the two operating points (Q_A and Q_B). (3%)
   (b) Please compare the magnitude of the transconductance (g_{mA} vs. g_{mB}) for the two operating points (Q_A and Q_B). (3%)

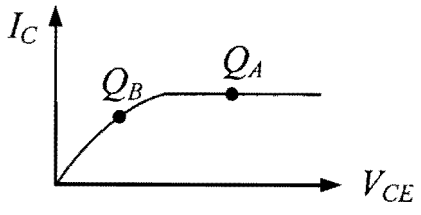

Figure 1

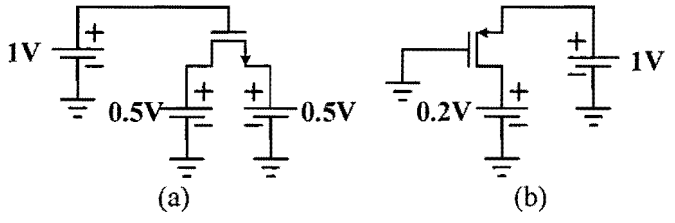

Figure 2

2. Please analyze and denote the operating regions (triode, saturation or cut-off) of the MOS circuits depicted in Fig. 2. Assume V_{THN}=| V_{THP} |=0.4V (4%)
3. Two outputs of the amplifier are specified in Fig. 3. Derive the voltage gain, v_{out1}/v_{in} and v_{out2}/v_{in} , respectively. Set λ=0 for M_1 and v_b as a fixed voltage. (10%)

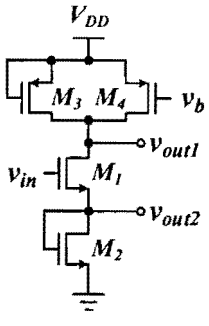

Figure 3

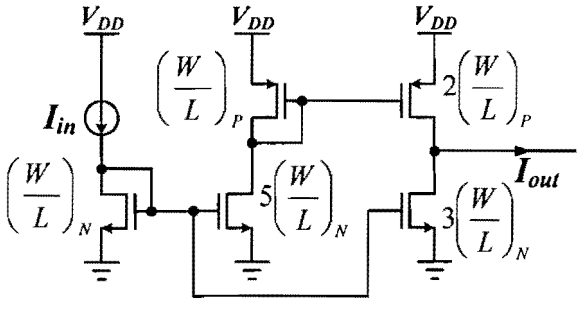

Figure 4

4. Assume all of the transistors drawn in Fig.4 operate in saturation region. Please calculate the current gain (=I_{out}/I_{in}). (10%)
5. Please identify the amplifier types in Fig. 5 and also denote the ideal requirements of the input/output impedances (R_{in}, R_{out}). The amplifier can be either of the following type : voltage, current, transimpedance and transconductance. (20%)

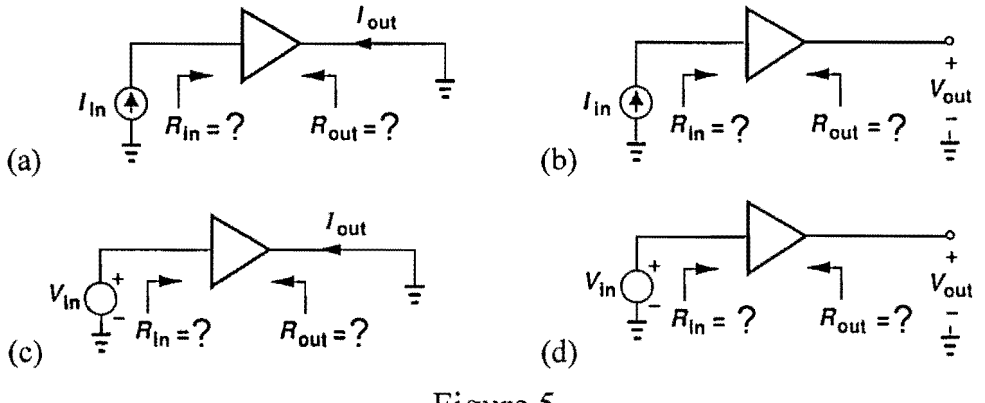

Figure 5

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6. Draw the small-signal equivalent circuit for the amplifier shown in Fig.6. (10%)

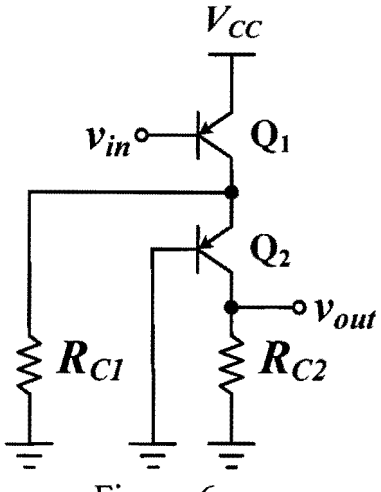


Figure 6

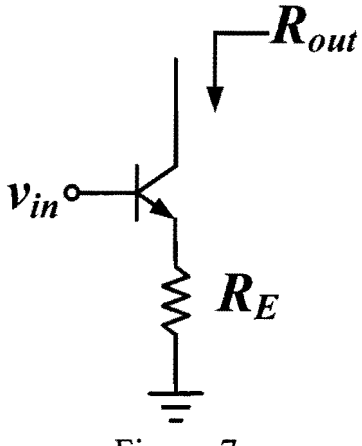


Figure 7

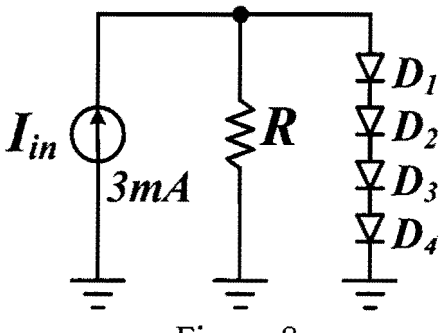
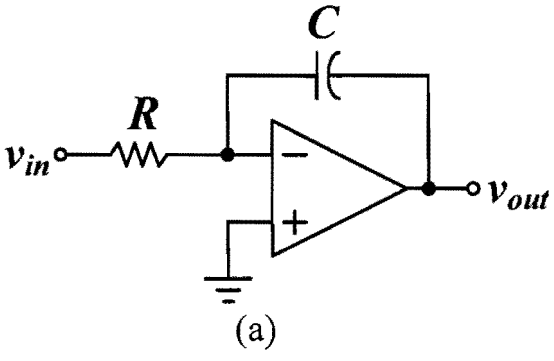


Figure 8

7. For the degenerated circuit depicted in Fig. 7, please perform the small signal analysis to derive the exact output resistance (R_{out}) and its simplified form detailed explanation. (15%)

8. For the circuit shown in Fig. 8, the current flowing through the resistor is 2.5 mA. Please calculate the voltage across the resistor and the required value of the resistor. Assume $I_S = 5 \times 10^{-16}$ A for each diode at room temperature. (10%)

9. For the two operational amplifier circuits shown in Fig. 9, please answer the following questions : (15%)
   (1) Derive the transfer functions and their pole or zero by assuming the gain of the operational amplifier is infinite. What are the main purposes of these two circuits?
   (2) If the gain of the operational amplifier is finite to be A_0, please recalculate the transfer functions and their pole or zero.



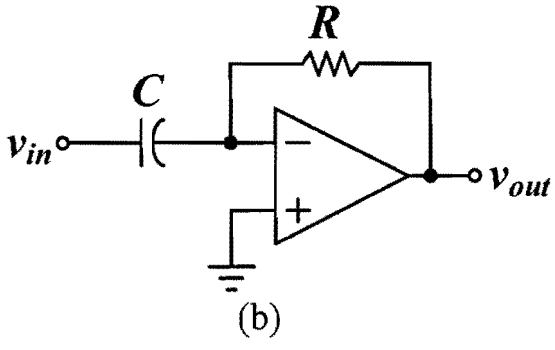


Figure 9