(電子學)

# 國立成功大學 78 學年度 電機工程研究所 考試( Electronics 試題)

1. (a) What are the two basic distinctions between a junction and an MOS capacitor ?
   (b) Describe how to make crossovers in the fabrication of bipolar and MOS integrated circuits, respectively.
   (c) Show that $g_m$ of an enhancement MOSFET can be expressed as $g_m = 2I_D/(V_{GS}-V_T)$, where $V_T$ is the threshold voltage.
   (d) Draw the small-signal model of a pn diode for both forward and reverse bias and explain the physical significance of each element. (16%)

2. For the circuit shown in Fig. 1(a), sketch the load line of $Q_1$ and the transfer curve of the circuit for $V_{DD} = 6$ V, where $Q_1$ and $Q_2$ are identical transistor described by Fig. 1(b). (12%)

3. For the BJT inverter shown in Fig. 2, sketch the transfer characteristics and determine the noise margins. (10%)

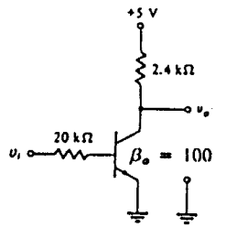



Fig. 2

4. (a) The system shown in Fig. 3(a) is an N:1 synchronous counter. Find the value of N and verify its operation with $Q_0 = Q_1 = 0$ as initial state.
   (b) Design an encoder satisfying the truth table shown in Fig. 3(b), using a diode matrix. (12%)

5. A transistor having $h_{fe} = \beta_o = 125$, $f_T = 300$ MHz, $C_c = C_\mu = 0.5$PF and $r_o \to \infty$is used in a common-emitter circuit and biased at $I_{CQ} = 1$ mA. For signal source resistance $R_S = 300\,\Omega$ and collector load resistance $R_C = 1.2$ KΩ, determine the midband gain $A_{Vo} = V_o/V_s$ and upper 3-dB frequency $f_H$. (15%)

6. The FET in the circuit shown in Fig. 4 has $g_m = 1$ mU, $r_d = 20$ KΩ.
   (a) Identify the feedback topology.
   (b) Find the input and output circuits without feedback, but taking the loading into account. Find (c) $G_{MF} = Io/Vs$, and (d) $A_{VF} = Vo/Vs$. (15%)

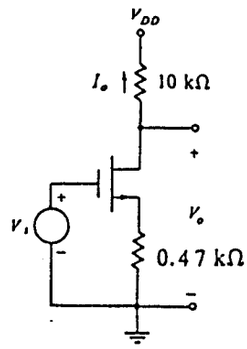
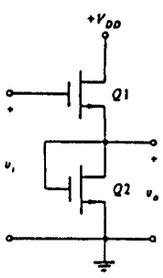
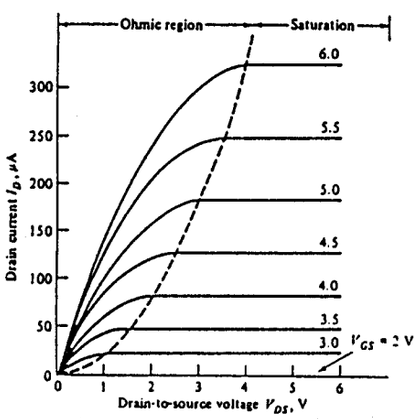



Fig. 4

7. (a) Sketch the circuit diagram of a simple current mirror, and explain how this circuit acts as a current source.
   (b) Draw the circuit diagram of a simple instrumentation amplifier using a single OP AMP. What are the resistances seen by each input source ?
   (c) Sketch the circuit of a noninverting Schmitt trigger. Find expressions for the threshold levels $V_1$ and $V_2$.
   (d) Draw the circuit of a class B push-pull power amplifier. State three advantages of class B over class A. (20%)

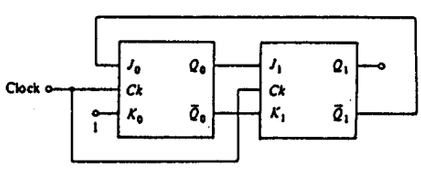



(a)




(b)

Fig. 1




(a)

| Inputs | | | | Outputs | | | |
|---|---|---|---|---|---|---|---|
| $W_3$ | $W_2$ | $W_1$ | $W_0$ | $Y_3$ | $Y_2$ | $Y_1$ | $Y_0$ |
| 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

(b)

Fig. 3