國立臺灣師範大學100學年度碩士班招生考試試題

科目：**電子學**　　適用系所：**光電科技研究所**

注意：1.本試題共 2 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

第 1~7 題選擇題，無需計算過程，第 8~13 題為計算作圖題，必需運算過程及完整繪圖

1. For an ideal OP-Amp, its input impedance (R_i) and output impedance (R_o) are: (1) $R_i=0$, $R_o=0$; (2) $R_i=0$, $R_o=\infty$; (3) $R_i=\infty$, $R_o=0$; (4) $R_i=\infty$, $R_o=\infty$; (5) not defined. (5 分)
2. The emitter, base, and collector voltages of an *npn* transistor are -0.7 V, 0 V, and -0.6 V, respectively. Please identify the mode of operation of this transistor. (1) active; (2) saturation; (3) inverted; (4) cut off. (5 分)
3. For Field Effect Transistors (FETs), choose the wrong statement(s) ? (1) The gate current, $I_G=0$; (2) There are JFET, depletion-type MOSFET, and enhancement -type MOSFET; (3) The drain current I_D is determined by V_G (gate voltage); (4) I_D is determined by I_G; (5) $I_G=\infty$. (5 分)
4. MOS technology is used to fabricate a capacitor, this is, the gate metallization and the substrate are used as the capacitor electrodes. Find the area required for obtaining 1 pF capacitance for oxide thickness 34.5 nm. (1) 10^0 μm^2; (2) 10^1 μm^2; (3) 10^2 μm^2; (4) 10^3 μm^2; (5) 10^4 μm^2. (5 分)
5. Compared to a MOS device, a bipolar device has (1) higher input impedance; (2) lower transconductance; (3) higher current driving capability; (4) current dominated by drift current. (5 分)
6. The definition of CMRR (common-mode rejection ratio) is: (1) A_c/A_d; (2) A_d/A_c; (3) V_c/V_d; (4) V_d/V_c. (5 分)
7. What operating modes do JFET and MOSFET have high input impedances ? (1) reverse & forward bias, respectively; (2) forward & revise bias, respectively; (3) insulating & reverse bias, respectively; (4) reverse bias & insulating, respectively; (5) insulating & forward bias, respectively; (6) forward bias & insulating, respectively. (5 分)
8. In Fig. 1,

   (a) Please identify which one is a BJT, also draw the small-signal hybrid-π model equivalent-circuit of BJT. (5 分)

   (b) Please identify which one is the Intel's MOSFET, also draw the ideal small-signal model equivalent-circuit of MOSFET. (5 分)

   (c) For MOSFET, please draw the small-signal Model equivalent-circuit including body effect. (5 分)

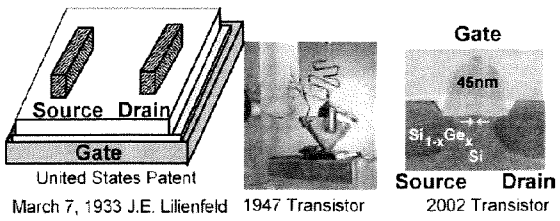

Fig. 1 (A) (B) (C)

9. Sketch a pseudo-NMOS realization of the exclusive-OR function $Y = \overline{A}B + A\overline{B}$ (10 分)
10. Please plot the circuit symbol (a) pnp transistor; (b) PMOSFET; (c) Schottky diode; (d) JFET; (e) p-n diode. (10 分)
11. For the OP-Amp shown in Fig. 2, find the relation between the output and input voltages. (10 分)
12. In Fig. 3, assume $\beta = 200$, $C_\mu = 1$ pF, and $f_T = 200$ MHz, (a) Find C_π = ? (b) Find mid-band voltage gain, A_M=? (c) Find 3-dB frequency, f_H=? (10 分)

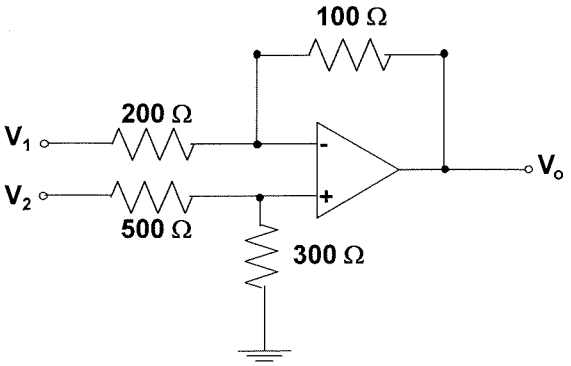

Fig. 2

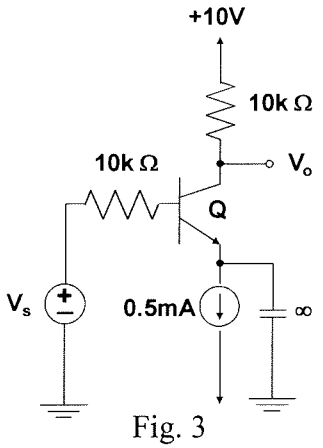

Fig. 3

13. Please identify the following semiconductor devices. (10 分)