

國立臺灣師範大學 101 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，否則依規定扣分。

第 1~6 題選擇題，無需計算過程，第 7~13 題為計算作圖題，必需運算過程及完整繪圖

1. For the circuit shown in Fig. 1 using ideal diodes, find the values of I and V (1) $I = 0$ mA, $V = 0$ V (2) $I = 1$ mA, $V = 1$ V (3) $I = 2$ mA, $V = 2$ V (4) $I = 3$ mA, $V = 3$ V (5) unknown (5 分)
2. For the circuit shown in Fig. 2, $R_1 = 1$ k Ω , voltage gain 50, band width $\omega_{3dB} = 10^4$ rad/s, please find $R_2 =$ (1) 0.01 k Ω (2) 0.02 k Ω (3) 1 k Ω (4) 50 k Ω (5) 100 k Ω (5 分)
3. Continue question 2, in Fig. 2, please find $C =$ (1) 10 μ F (2) 5 μ F (3) 100 nF (4) 2 nF (5) 1 nF (5 分)
4. 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)
5. 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)
6. The emitter, base, and collector voltages of an *n*pn transistor are -0.7 V, 0 V, and -0.6 V, respectively. Please identify the mode of operation of the transistor. (1) active (2) saturation (3) inverted (4) cut off (5 分)
7. The circuit shown in Fig. 3 represents the equivalent circuit of an unbalanced bridge. Note $R_1 = 1$ k Ω , $R_2 = 1.2$ k Ω , $R_3 = 9.1$ k Ω , $R_4 = 11$ k Ω , and $R_5 = 3$ k Ω . It is required to calculate the current in the detector branch (R_5) and the voltage across it. Although this can be done using loop and node equations, a much easier approach is possible: Find the Thevenin equivalent of the circuit to the left of node 1 and the Thevenin equivalent of the circuit to the right of node 2. Then solve the resulting simplified circuit. (10 分)

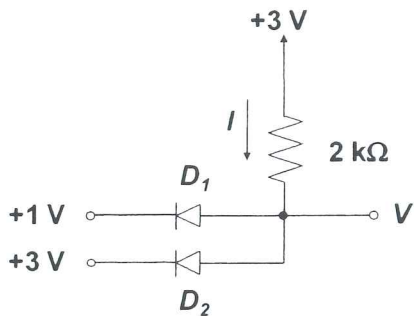


Fig. 1

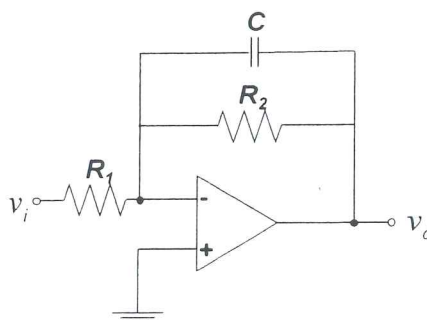


Fig. 2

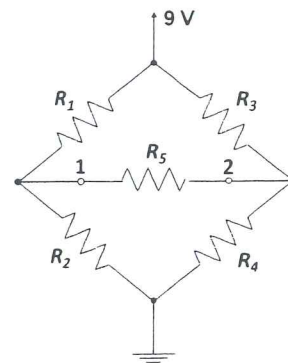


Fig. 3

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8. Please draw the small-signal Model equivalent-circuit of MOSFET including body effect. (10 分)
9. The circuit in Fig. 4 is frequently used to provide an output voltage v_o proportional to the input signal current i_i . Derive expressions for the transresistance $R_m \equiv v_o / i_i$, and the input resistance $R_i \equiv v_i / i_i$ for the following cases: (a) A is infinite. (b) A is finite. (10 分)
10. The FET-input OP AMP gives an output of 0.5 V when connected as shown in Fig. 5 ($R_1 = 100 \Omega$, $R_2 = 33 \text{ k}\Omega$) (a) What is the input offset voltage, V_{os} ? (b) Now, R_1 is changed to 50 k Ω , R_2 is replaced by a 1 nF capacitor, find V_o as a function of t . ($V_o(t=0) = 0 \text{ V}$, and $V_{osat} = \pm 13 \text{ V}$) (10 分)
11. A BJT for which BV_{CBO} is 30 V is connected as shown in Fig. 6. What voltages would you measure on the collector, base, and emitter? (10 分)
12. Can two back-to-back connected p-n junction diodes be used as a transistor? Why? (10 分)
13. Consider the storage capacitor for panel display application $\sim \exp(-t/RC)$, t is time. Assume the $\epsilon_{LC} \times \epsilon_0 = 7 \times 8.85 \times 10^{-14} \text{ F/cm}$, and the initial voltage is 3 V. Please calculate the voltage after 16.67 ms (60Hz refresh rate) with (a) the resistance of liquid crystal $\sim 10^{11} \Omega\text{-cm}$, (b) the resistance of liquid crystal $\sim 10^{13} \Omega\text{-cm}$ for currently process. (10 分)

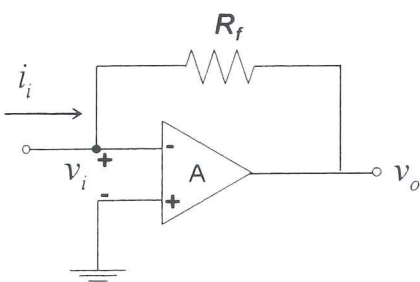


Fig. 4

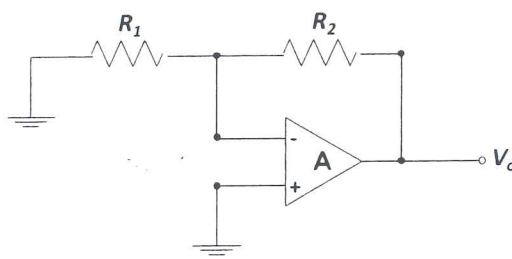


Fig. 5

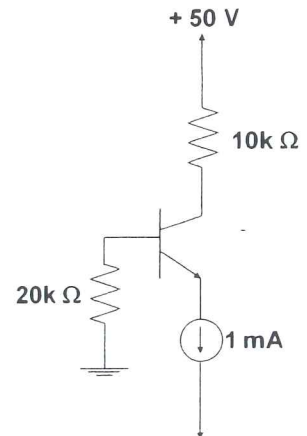


Fig. 6