

# 國立彰化師範大學 101 學年度碩士班招生考試試題

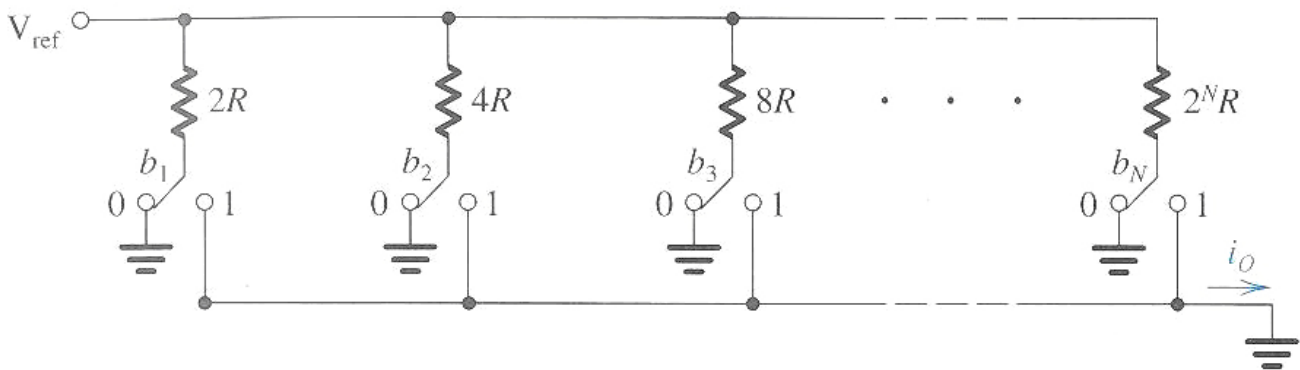
系所： 資訊工程學系積體電路設計碩士班

科目： 電子學

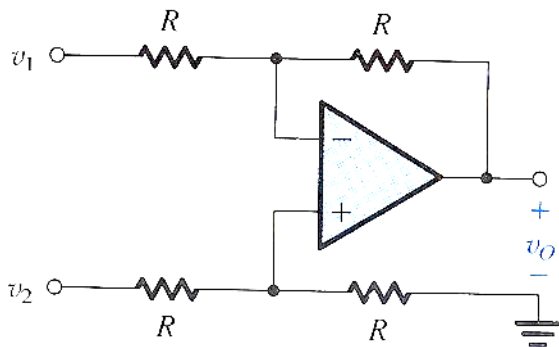
☆☆請在答案卷上作答☆☆

共 2 頁，第 1 頁

1. (15%) The following figure shows the circuit of an  $N$ -bit digital-to-analog converter (DAC). Each of the  $N$  bits of the digital word to be converted controls one of the switches. When the bit is 0, the switch is in the position labeled 0; when the bit is 1, the switch is in the position labeled 1. The analog output is the current  $i_o$ .  $V_{\text{ref}}$  is a constant reference voltage.
- (a) Which bit is the LSB? Which is the MSB?
- (b) For  $V_{\text{ref}} = 5\text{V}$ ,  $R = 5\text{ k}\Omega$ , and  $N = 4$ , find the maximum value of  $i_o$  obtained. What is the change in  $i_o$  resulting from the LSB changing from 0 to 1?



2. (15%) For the circuit shown in the following figure, express  $v_o$  as a function of  $v_1$  and  $v_2$ . What is the input resistance seen by  $v_1$ ? By  $v_2$  alone? By a source connected between the two input terminals? By a source connected to both input terminals simultaneously?



3. (20%) A diode has  $N_A = 10^{17}/\text{cm}^3$ ,  $N_D = 10^{16}/\text{cm}^3$ ,  $n_i = 1.5 \times 10^{10}/\text{cm}^3$ ,  $L_p = 5\text{ }\mu\text{m}$ ,  $L_n = 10\text{ }\mu\text{m}$ .  $A = 2500\text{ }\mu\text{m}^2$ ,  $D_p$  (in the  $n$  region)  $= 10\text{ cm}^2/\text{Vs}$ , and  $D_n$  (in the  $p$  region)  $= 18\text{ cm}^2/\text{Vs}$ . The diode is forward-biased and conducting a current  $I = 0.1\text{ mA}$ . Calculate: (a)  $I_S$ ; (b) The forward-bias voltage  $V$ ; (c) The component of the current  $I$  due to hole injection and that due to electron injection across the junction; (d)  $\tau_p$  and  $\tau_n$ ; (e) excess hole charge in the  $n$  region  $Q_p$ , and the excess electron charge in the  $p$  region  $Q_n$ , and hence the total minority stored charge  $Q$ , and the transit time  $\tau_T$ ; (f) the diffusion capacitance.

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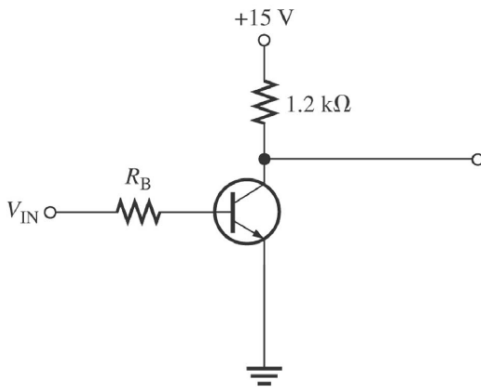
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共 2 頁，第 2 頁

4. (30%) For the circuit shown in the following figure,  
(a) What is  $V_{CE}$  when  $V_{in} = 0V$ ?  
(b) What minimum value of  $I_B$  is required to saturate this transistor if  $\beta_{DC}$  is 200?  
(c) Calculate the maximum value of  $R_B$  when  $V_{in} = 5V$ ?



5. (20%) Determine the critical frequency of the bypass RC circuits for the amplifier in the following figure ( $r_e = 12\Omega$ )?

