

國立臺灣科技大學

九十學年度碩士班招生考試試題

系所組別：電子工程系乙一組、電子工程系乙二組、電子工程系乙三組

科目：電子電路學

1. An emitter follower is shown in Fig. 1.

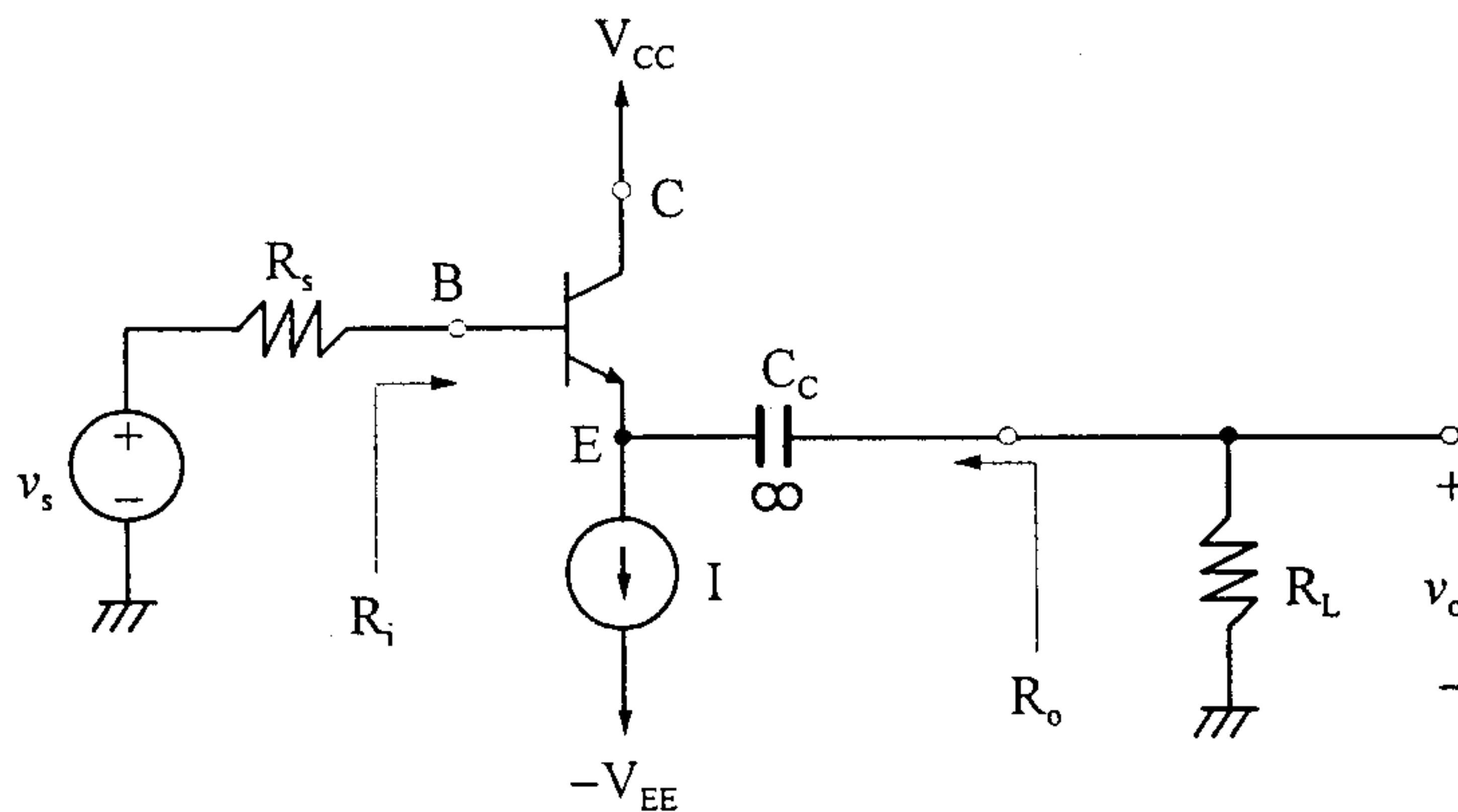
(a) Please replace the BJT with its T model to determine its input resistance R_i , outputresistance R_o and the voltage gain $\frac{v_o}{v_s}$. (15 %)(b) The discussed emitter follower has an open-circuit voltage gain of 0.99 and an output resistance of $200\ \Omega$ when driven from a $10\text{-k}\Omega$ source. R_o increases to $300\ \Omega$ when R_s is increased to $20\text{ k}\Omega$. Please find the voltage gain when the emitter follower is driven by a $5\text{-k}\Omega$ source and loaded by a $5\text{-k}\Omega$ resistor. (10 %)

Fig. 1

2. Fig. 2 depicts the input stage of a simplified op amp circuit. It consists of two matched transistor pairs, namely, the differential pair Q_1 and Q_2 , and the current mirror Q_3 and Q_4 .(a) Please express i_o in terms of I_A , the thermal voltage V_T , and the input voltage difference $(v_P - v_N)$. (10 %)(b) The transconductance g_m is defined as $\left. \frac{di_o}{d(v_P - v_N)} \right|_{v_P = v_N}$. Please express g_m in terms of I_A and V_T . (10 %)(c) If i_o reaches $\pm 95\%$ of I_A due to the imbalance between v_P and v_N , the input stage is regarded saturated. Please determine the minimum input voltage difference required to cause saturation, given $V_T = 25\text{ mV}$ at room temperature and $\tanh^{-1}(0.95) \cong 1.83$. (10 %)

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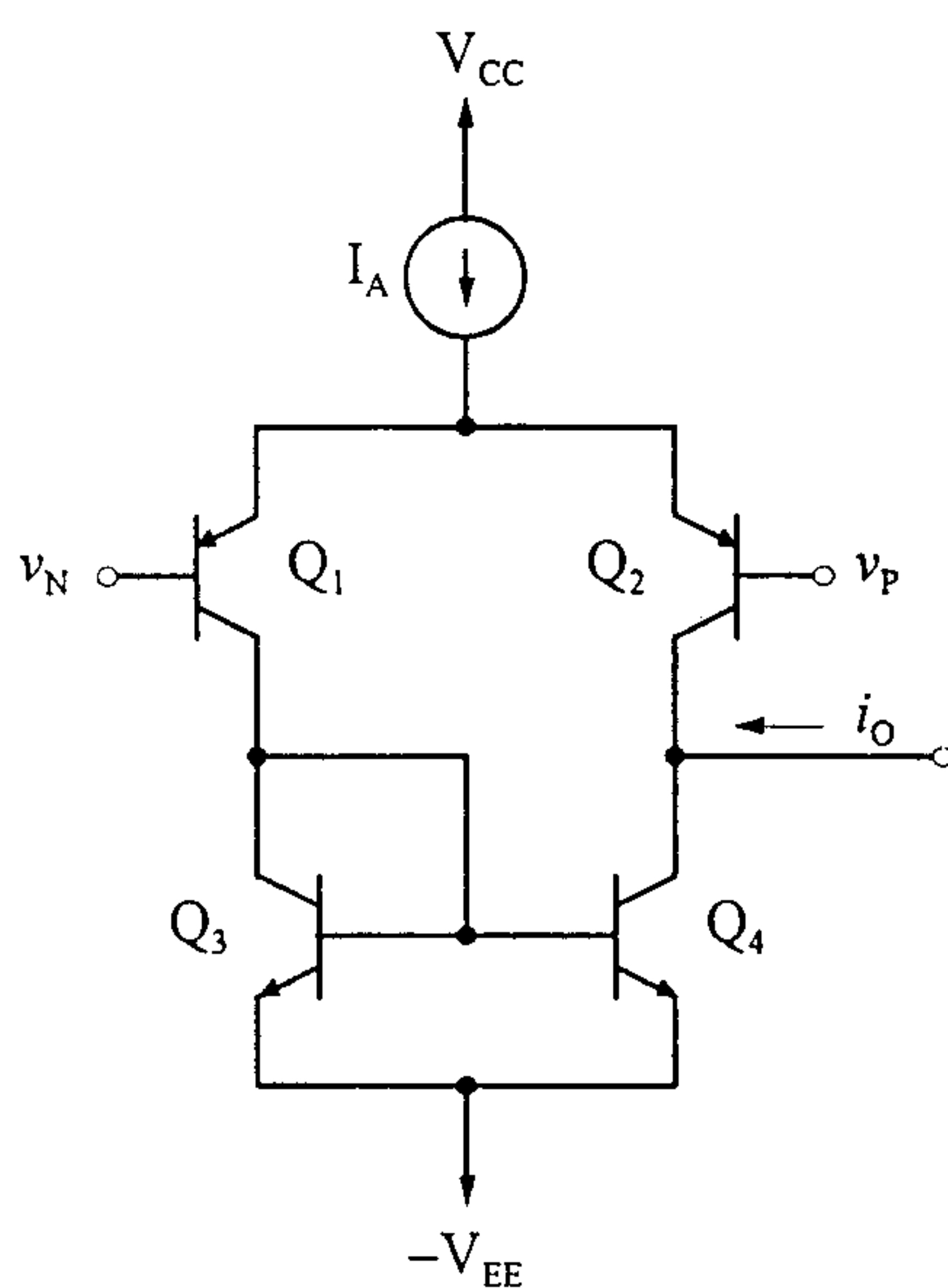


Fig. 2

3. A Wien-bridge oscillator with automatic amplitude control is shown in Fig. 3, where A is an ideal op amp. R_3 , R_4 , D_1 and D_2 compose a limiter circuit.
- (a) Disregard the limiter circuit, please determine the loop gain $L(s)$. (5 %)
- (b) With $R = 158 \text{ k}\Omega$, $C = 1 \text{ nF}$, $R_1 = 10 \text{ k}\Omega$, $R_2 = 21 \text{ k}\Omega$, $R_3 = 3 \text{ k}\Omega$, $R_4 = 21 \text{ k}\Omega$, $V_s = 15 \text{ V}$, and V_D (the voltage drop of a forward-conducting diode) = 0.7 V , please determine the frequency and the amplitude of v_O when the steady state is reached. (15 %)

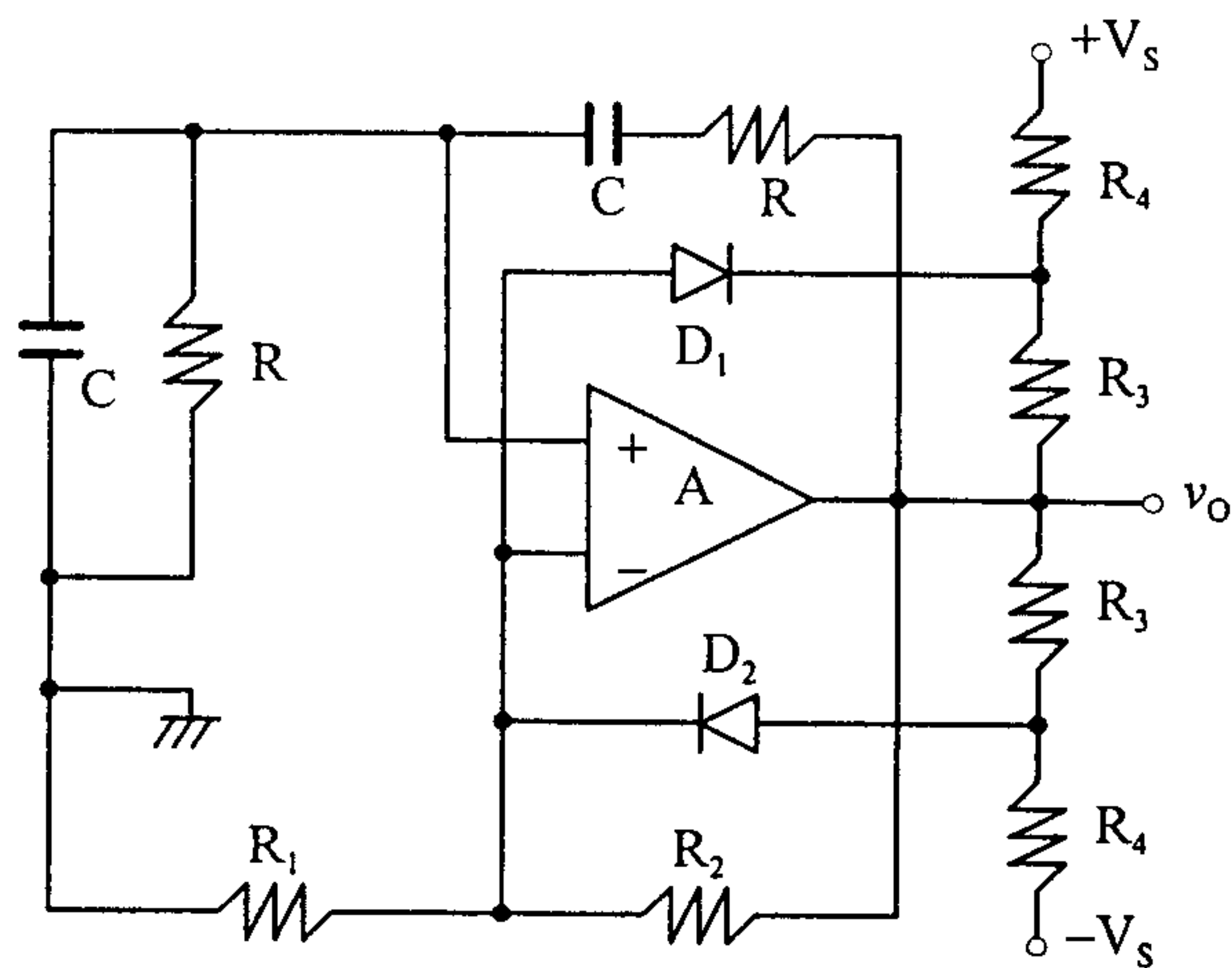


Fig. 3

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4. The BJT in the circuit shown in Fig. 4 begins to conduct at $v_{BE} = 0.7$ V and is fully conducting at $v_{BE} = 0.8$ V. The same applies to D. The schottky diodes have a voltage drop of 0.5 V when conducting.
- (a) What is the logic function performed? (5 %)
- (b) Find the noise margins. (10 %)
- (c) Find the current drawn from the supply when $A = 1.0$ V, $B = 1.3$ V and $C = 0.3$ V. (10 %)

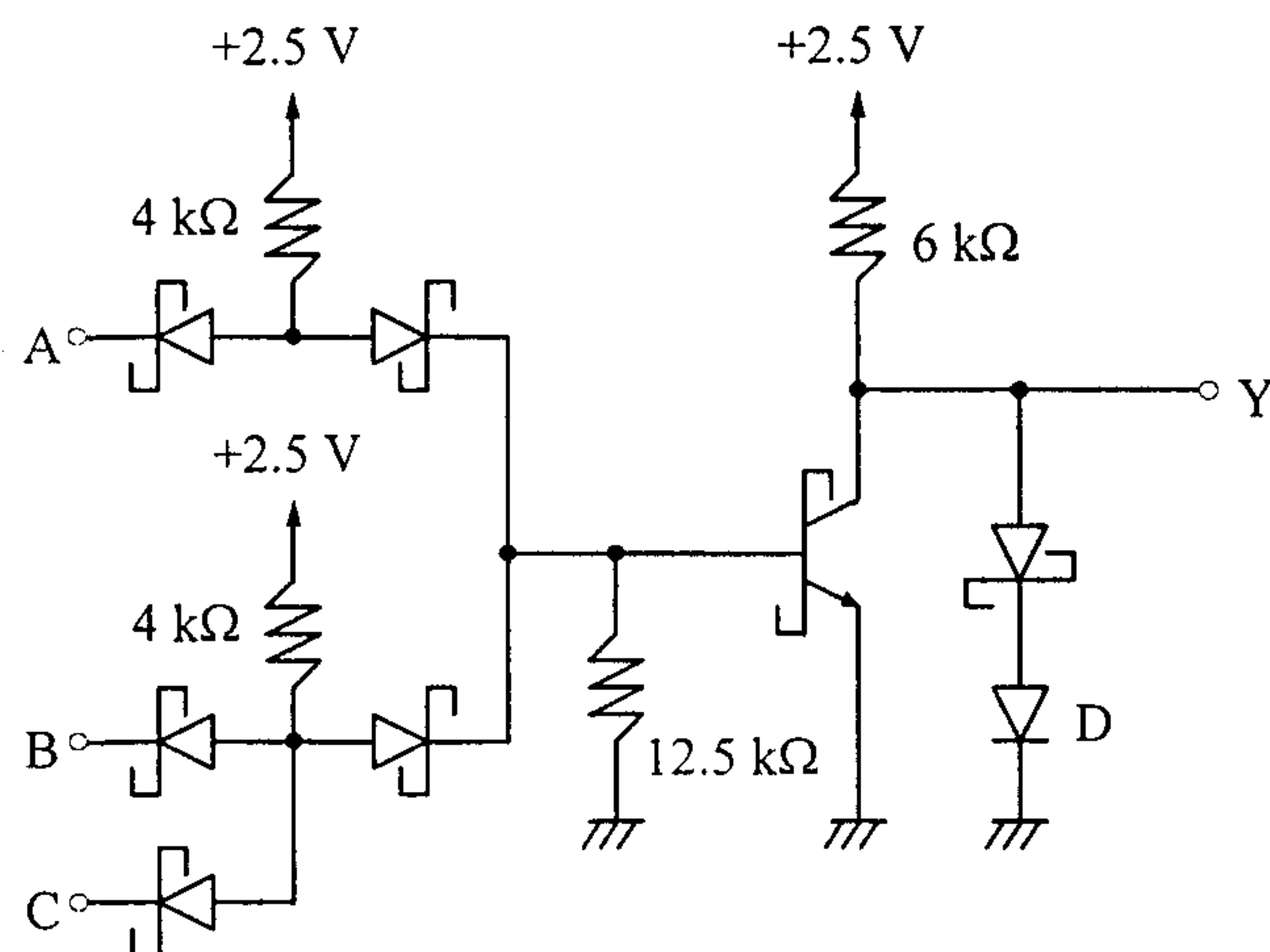


Fig. 4

