國立彰化師範大學 97 學年度碩士班招生考試試題

系所：光電科技研究所碩士班　　科目：電子學

☆☆請在答案紙上作答☆☆　　共 3 頁，第 1 頁

1. A zener diode whose nominal voltage is 10 V at 10 mA has an incremental of 50 Ω. What voltage do you expect if the diode current is halved? doubled? What is the value of V_{Z0} of the zener model? (15%)

2. Consider a half-wave rectifier circuit with a tri-angular-wave input of 16-V peak-to-peak amplitude and zero average and with R = 1 kΩ. Assume that the diode can be represented by the piecewise-linear model with V_{D0} = 0.65 V and r_D = 20 Ω. Find the average value of v_O (output voltage). (15%)

3. (a) A *pnp* transistor has v_{EB} = 0.8 V at a collector current of 1 A. What do you expect v_{EB} to become at i_C = 10 mA? at i_C = 5 mA? (10%)
   (b) A *pnp* transistor has a common-emitter current gain of 50. What is its common-base current gain? (10%)

(第 4~6 題題目係參考 Sedra & Smith "Microelectronic Circuits 5th")

4. (本題配分共 20%)
   The Amplifier of Fig 1 consists of two identical common-emitter amplifiers connected in cascade. Observe that the input resistance of the second stage, R_{in2}, constitutes the load resistance of the first stage.

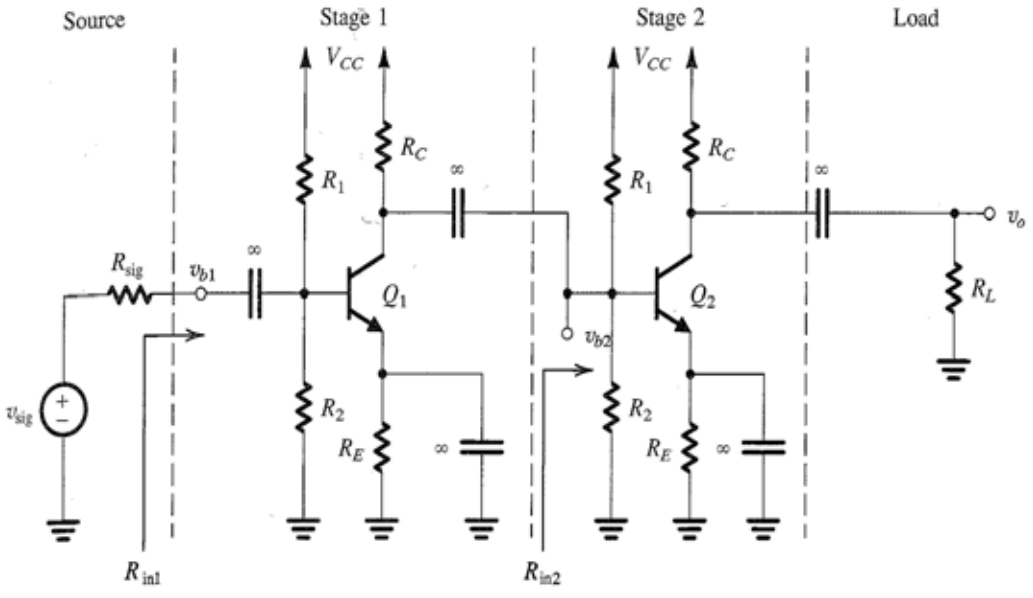

Fig 1

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(a) For V_{CC}=15 V, R_1=100 kΩ, R_2=50 kΩ, R_E=5 kΩ, R_C=5 kΩ, and β=100, determine the dc collector current and the dc collector voltage of each transistor. (Neglect the I_B current. All the capacitors are perfect.) (4%)

(b) Draw the small-signal equivalent circuit of the entire amplifier and give the values of all its components. Neglect r_{o1} and r_{o2}. (Using the Hybrid-π Model) (4%)

(c) Find R_{in1} and v_{b1}/v_{sig} for R_{sig} = 5 kΩ. (4%)

(d) Find R_{in2} and v_{b2}/v_{b1}. (4%)

(e) For R_L = 2 kΩ, find v_o/v_{b2}. (2%)

(f) Find the overall voltage gain v_o/v_{sig}. (2%)

5. (本題配分共 15%)

For a particular high frequency amplifier modeled by the circuit of Fig 2, g_m = 4 mA/V, R_{sig} = 180 kΩ, R_{in} = 0.8 MΩ, R_L'= 10 kΩ, C_{gs} = 3 pF, and C_{gd} = 0.8 pF. There is also an output capacitance C_L'= 4 pF. Assuming all the capacitors are perfect.

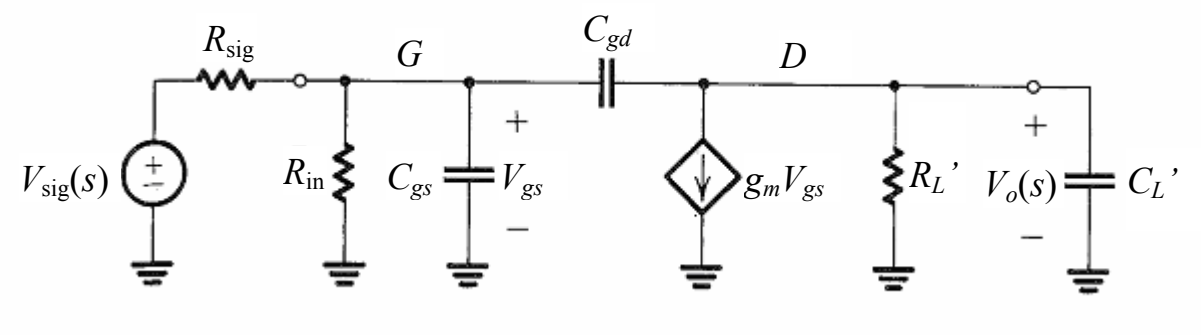

Fig 2

(a) Find the corresponding midband voltage gain $|v_o/v_{sig.}|$ (4%)

(b) Find the open-circuit time constant. (6%)

(c) Explain the meaning of 3-dB frequency (3%), and find it. (2%)

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6. (本題配分共 15%)

The differential amplifier circuit of Fig 3 utilizes a resistor connected to the negative power supply to establish the bias current *I*.

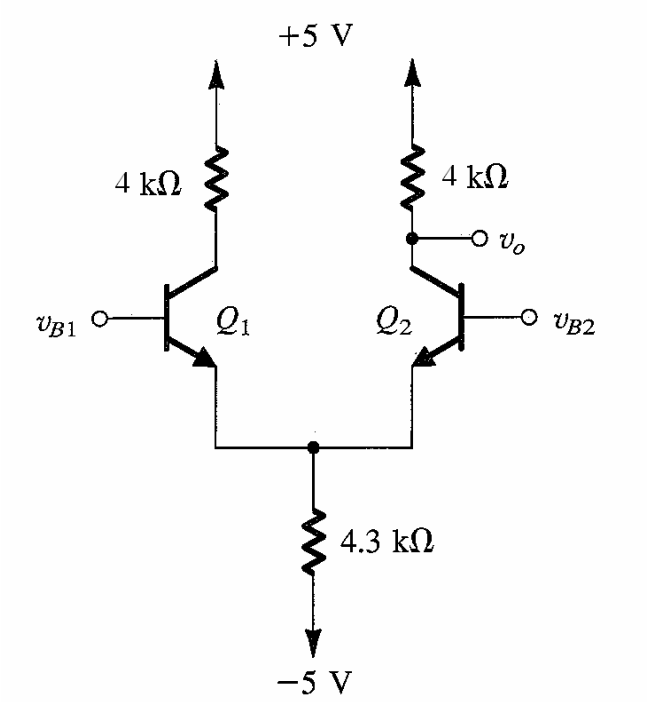

Fig 3

(a) Sketch it differential half circuit. (4%)

(b) For $v_{B1} = v_{id}/2$ and $v_{B2} = -v_{id}/2$, where v_{id} is a small signal with zero average, find the magnitude of the differential gain $|v_o/v_{id}|$. (2%)

(c) For $v_{B1} = v_{B2} = v_{icm}$, find the magnitude of the common mode gain, $|v_o/v_{icm}|$. (2%)

(d) Explain the meaning of CMRR (4%), and find it (3%).