國立彰化師範大學 99 學年度碩士班招生考試試題

系所：光電科技研究所　　選考乙　　科目：電子學

☆☆請在答案紙上作答☆☆　　

部分題目參考

Sedra & Smith "Microelectronic Circuits 5th"和 B. Razavi "Fundamentals of Microelectronics"

1. A diode is biased at a current of 1 mA. (1) Determine the current change if the voltage (V_D) of the diode changes by 1 mV. (2) Determine the voltage change if the current (I_D) changes by 10%. (10%)
2. Calculate the voltage gain, the input impedance (R_{in}) and the output impedance (R_{out}) of the stage depicted in **Figure 1** if $V_A = \infty$ and C_B is very large. (Note: the small-signal parameters g_m and r_π) (15%)
3. A common-base amplifier is designed for an input impedance of R_{in} and an output impedance of R_{out}. Neglecting Early effect, determine the voltage gain of the circuit. (10%)
4. Assuming $A_o = \infty$, compute the closed-loop gain of the inverting amplifier shown in **Figure 2**. (15%)
5. For the common-emitter amplifier shown in **Figure 3**, let V_{CC} = 10 V, R_1 = 30 kΩ, R_2 = 20 kΩ, R_E = 2 kΩ, and R_C = 4 kΩ. The transistor has β = 100 and V_A = 100 V. If the amplifier operates between a source for which R_{sig} = 20 kΩ, and a load R_L = 5 kΩ. (25%)
   (1) Calculate the dc bias I_E.
   (2) Replace the transistor with its hybrid-π model. Draw the small-signal equivalent circuit of the entire amplifier and give the values of all its components.
   (3) Find the values of R_{in}.
   (4) Find the voltage gain $v_o/v_{sig.}$
   (5) Find the current gain i_o/i_i.
6. **Figure 4** shows an idea voltage amplifier having a gain of −200 V/V with an impedance Z connected between its output and input terminals. Find the Miller equivalent circuit when Z is (a) a 5 MΩ resistance, and (b) a 2 pF capacitance. In each case use the equivalent circuit to determine v_o/v_{sig}. (c) Determine the f_{3dB} of case (b). (15%)
7. The differential amplifier in **Figure 5** uses transistors with β=200. Evaluate (10%)
   (1) The overall differential voltage gain v_o/v_{sig} (neglect the effect of r_o).
   (2) If the R_C is changed to 20 kΩ, what is the new gain $v_o/v_{sig.}$

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Figure 1

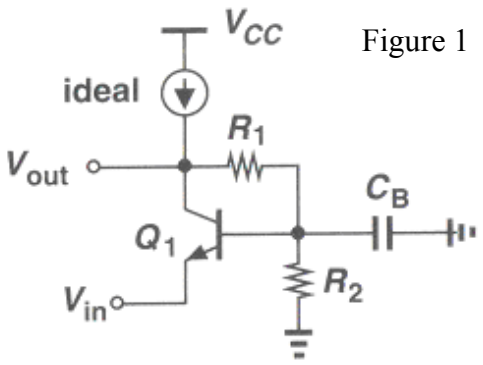

Figure 2

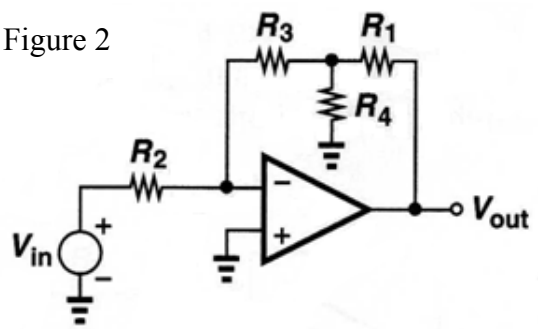

Figure 3

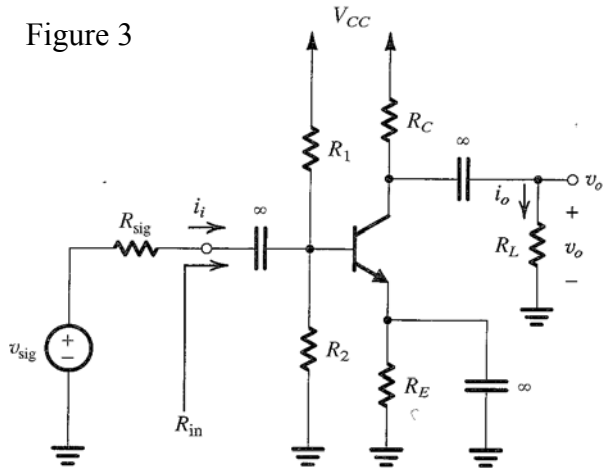

Figure 4

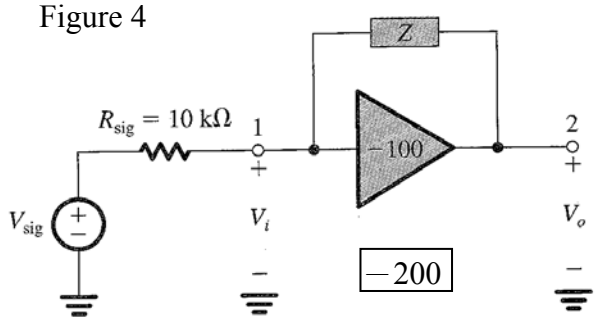

Figure 5