國立成功大學

112學年度碩士班招生考試試題

編　號：130

系　所：系統及船舶機電工程學系

科　目：電子學

日　期：0206

節　次：第 2 節

備　註：可使用計算機

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※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Use two ideal op amps and resistors to implement the summing function (20%)

$$v_O = v_1 + 2v_2 - 3v_3 - 5v_4$$

2. As Figure 1, derive the transfer function and show that the high-frequency gain is $(-R_2/R_1)$ and the 3-dB frequency $\omega_0=1/CR_1$. Design the circuit to obtain a high-frequency input resistance of 1kΩ, a high-frequency gain of 40 dB, and a 3-dB frequency of 2 kHz. At what frequency does the magnitude of the transfer function reduce to unity? (20%)

3. In the circuit of Figure 2, the BJT is biased with a constant-current source, and v_{sig} is a small sine-wave signal. Find R_{in} and the gain v_o/v_{sig}. Assume β=100. If the amplitude of the signal v_{be} is to be limited to 5 mV, what is the largest signal at the input? What is the corresponding signal at the output? (20%)

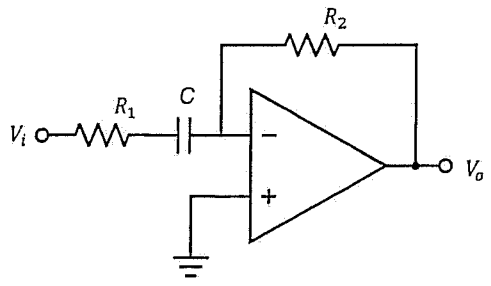

Figure 1

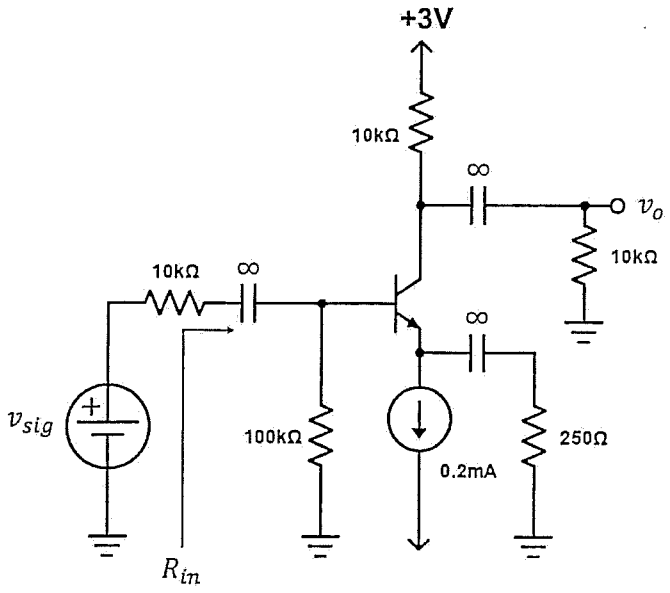

Figure 2

4. Transistor Q_1 in Figure 3 is operating as a CE amplifier with an active load provided by transistor Q_2, which is the output transistor in a current mirror formed by Q_2 and Q_3. (Note that the biasing arrangement for Q_1 is *not* shown.)
   (a) Neglecting the finite base currents of Q_2 and Q_3, and assuming that their V_{BE}≅0.7V and that Q_2 has five times the area of Q_3, find the value of I. (5%)
   (b) If Q_1 and Q_2 are specified to have $|V_A|$= 20 V, find r_{o1} and r_{o2} and hence the total resistance at the collector of Q_1. (5%)
   (c) Find $r_{\pi 1}$ and g_{m1} assuming that β_1= 50. (5%)
   (d) Find R_{in}, A_v, and R_o. (5%)

5. The amplifier in Figure 4 is biased to operate at g_m= 5mA/V, and has the following component values: R_{sig}= 100 kΩ, R_{G1}= 47MΩ, R_{G2}= 10MΩ, C_{C1}= 0.01μF, R_S= 2 kΩ, C_S= 10μF, R_D= 4.7kΩ, R_L= 10kΩ, and C_{C2}= 1μF. Find A_M, f_{P1}, f_{P2}, f_Z , f_{P3}, and f_L. (20%)

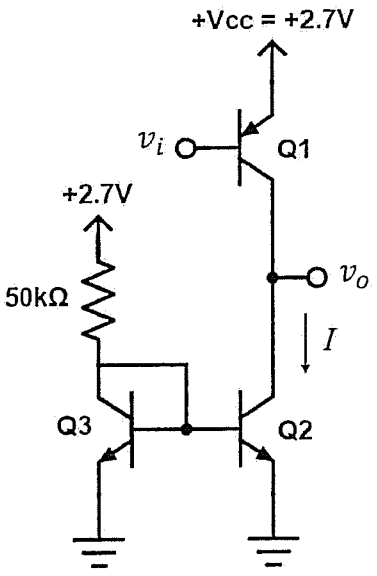

Figure 3

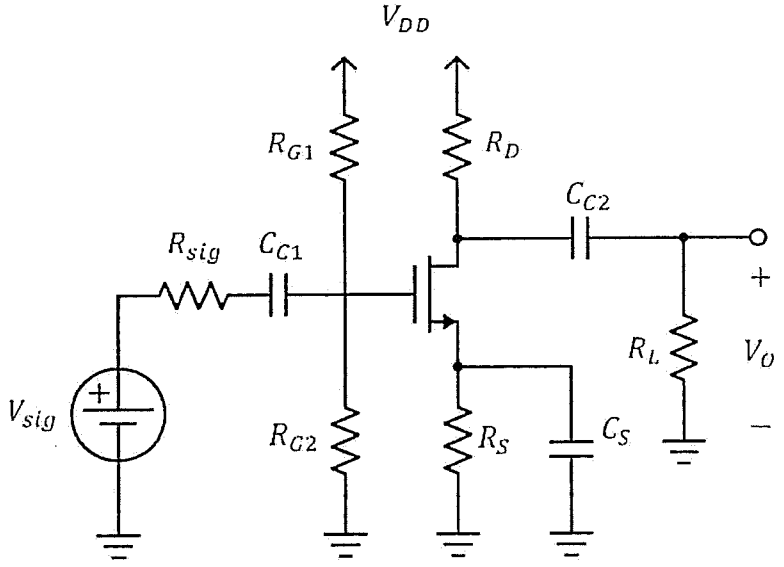

Figure 4