國立臺灣科技大學

九十一學年度碩士班招生考試試題

系所組別： 電機工程系乙二組、電機工程系丙二組

科　目： 電子學

1. For the circuit shown in Fig.P1,
   (a) Derive an expression for the transfer function V_o/V_i. (5%)
   (b) Find expressions for the magnitude and phase of the response. (5%)

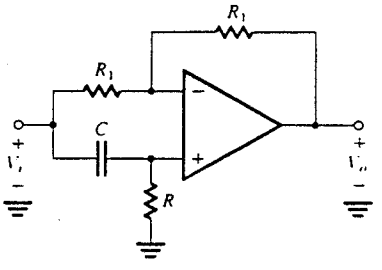

Fig.P1

2. In the circuit of Fig.P2, v_s is a small sine-wave signal with zero average. The transistor β is 100.
   (a) Find the value of R_E to establish a dc emitter current of about 1 mA. (5%)
   (b) Find R_C to establish a dc collector voltage of about +5 V. (5%)
   (c) For $R_L = 5\ \text{k}\Omega$ and the transistor $r_o = 100\ \text{k}\Omega$, draw the small-signal equivalent circuit of the amplifier and determine its overall voltage gain. (10%)

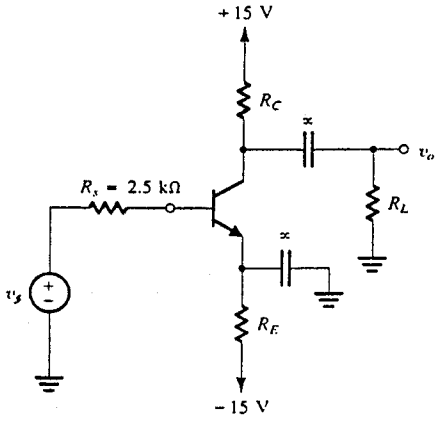

Fig.P2

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3. Consider the FET amplifier of Fig.P3 for the case $V_t = 2\text{V}$, $k_n'(W/L) = 1\ \text{mA/V}^2$, $V_{GS} = 4\ \text{V}$, $V_{DD} = 10\ \text{V}$, and $R_D = 3.6\ \text{k}\Omega$.
   (a) Find the dc quantities I_D and V_D. (5%)
   (b) Calculate the value of g_m at the bias gain. (5%)
   (c) Calculate the value of the voltage gain. (5%)
   (d) If the MOSFET has $\lambda = 0.01\ \text{V}^{-1}$, find r_o at the bias point and calculate the voltage gain. (5%)

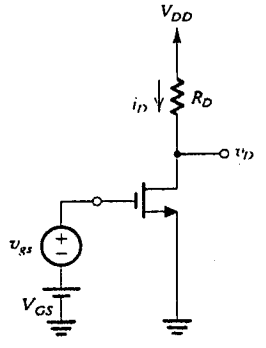

Fig.P3

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4. We want to analyze the circuit of Fig. P4. The feedback is provided by R_f as shown in Fig. P4. In addition, the transistor has $\beta = 100$.

(a) Determine the small-signal voltage gain $\frac{V_o}{V_s}$ (10%).

(b) Determine the input resistance R_{in} (5%).

(c) Determine the output resistance $R_{out} = R_{of}$ (5%).

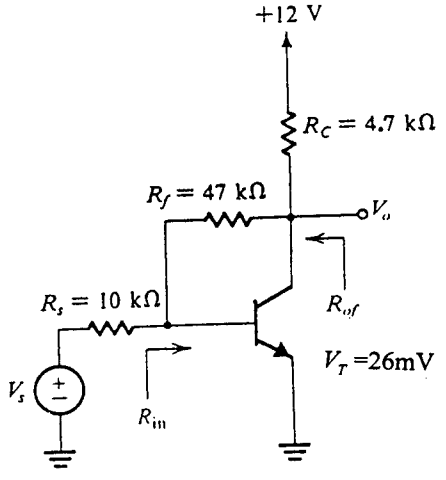

Fig. P4

5. The differential amplifier shown in Fig. P5 is biased with an ideal current source. The signal sources have nonzero output resistances represented by R_B. The small-signal differential input v_d is $v_1 - v_2$. The transistor parameters are $\beta = 120$, V_T (the thermal voltage) =26mV, and V_A (the Early Voltage) = ∞.

(a) Using the small-signal equivalent circuit, derive the expression for the differential-mode voltage gain $A_d = v_o / v_d$ (5%).

(b) Calculate the value of A_d (5%).

(c) Compute the differential-mode voltage gain obtained when $R_B = 0$ (5%).

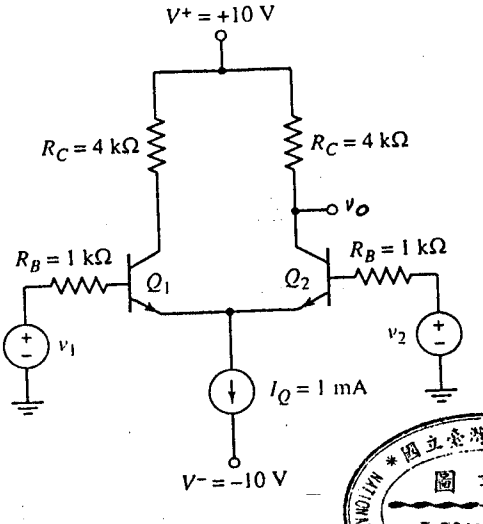

Fig. P5

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6. Consider the phase-shift oscillator shown in Fig. P6.

(a) Derive the expression for the frequency of oscillation. (10%)

(b) If $R=5K\,\Omega$, find the values of C and R_F that will produce sustained oscillations at 5 kHz. (5%)

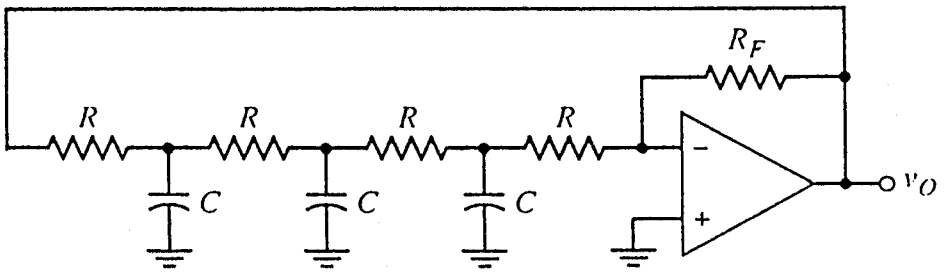

Fig. P6