國立臺南大學 104 學年度　**電機工程學系碩士班**　招生考試　電子學　試題卷

1. Explanation: (20%)

(a) Design a voltage follower by an OP amp and describe its advantages.

(b) Design a superdiode by an OP amp and show its transfer characteristic.

(c) Describe the base-width modulation effect in BJT.

(d) Draw the current flow in a PMOS transistor biased to operate in saturation region and explain the channel length modulation effect and the effect on output resistance of MOSFET.

2. A voltage amplifier has the transfer function

$$A_v = \frac{100}{(1+j\frac{f}{10^4})(1+\frac{10^2}{jf})}$$

Using the bode plots for low-pass and high-pass STC network, sketch a Bode for ｜Av｜. Give approximate values for the gain magnitude at f=10Hz, 10^2Hz, 10^3Hz, 10^4Hz, 10^5Hz, 10^6Hz, and 10^7Hz. Find the bandwidth of the amplifier. (10%)

3. The enhancement transistors in Figure 1 have $I_D=100(V_{GS}-3)^2$ uA. The depletion transistor has $I_D=100(V_{GS}+1)^2$ uA. Determine I_{D1}. (10%)

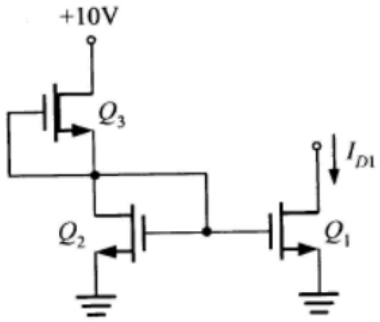

Figure 1

4. We wish to analyze the circuit in Figure 2 to determine the voltages at all nodes and the currents through all branches. (10%)

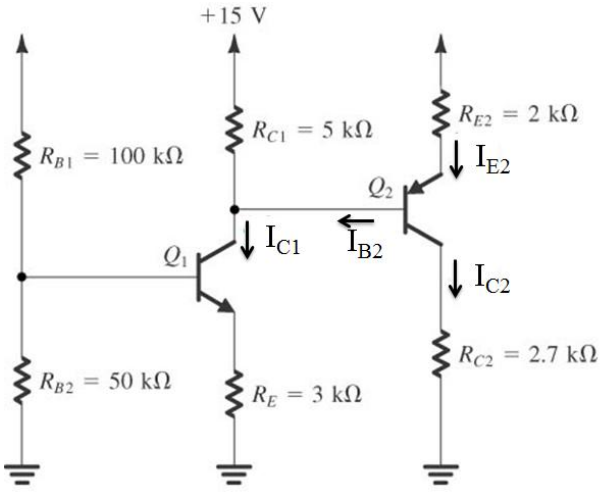

Figure 2

5. Determine the following voltages in $dB_{\mu}V$ and dB_m : (10%)
   (a) 30 V (b) 0.5 μV (c) 23 mV

6. A 50 Ω oscillator is attached to the high-impedance input of an oscilloscope (C_{in}=47 pF, R_{in}=1 MΩ). The source is tuned to 100MHz and the level set to -30 dB_m. Determine the voltage level (peak) of the sinusoid seen on the oscilloscope. (10%)

7. Construct the pole-zero diagram for the circuits shown in Figure 3 (a) and 3(b). (10%)

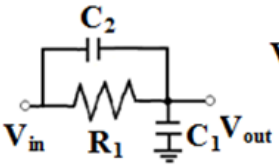

Figure 3(a)

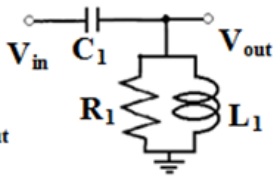

Figure 3(b)

8. For the Hartley oscillator of Figure 4, evaluate the frequency of oscillation and state the oscillation condition in the equivalent form. (10%)

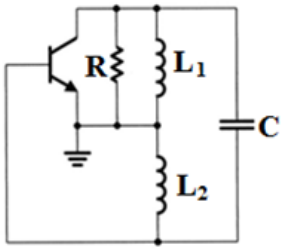

Figure 4

9. Design a BJT current mirror with a nominal current transfer ratio of unity. Let the transistors have $I_s=10^{-15}$ A, β=100, and V_A=100 V. For I_{REF}=1 mA. Find I_O when V_O=5 V. Also find the output resistance. (10%)