國立臺南大學 103 學年度　**電機工程學系碩士班**　招生考試　電子學　試題卷

共九題，每題配分標明於題目後，合計 100 分。

1. Explanation: (15%)
   (a) What is channel length modulation in MOSFET and the effect on output resistance of MOSFET?
   (b) Describe the BJT modes of operation and the current flow in an npn transistor biased to operate in active mode.
   (c) Write down the equation of a pn junction diode and draw the current-voltage curve.

2. The circuit in Fig. 1 utilizes an ideal op amp. (15%)
   (a) Find I_1, I_2, I_3, and V_X.
   (b) If V_O is not to lower than -13 V, find the maximum allowed value for R_L.
   (c) If R_L is varied in the range 100Ω to 1 kΩ, what is the corresponding change in I_L and in V_O?

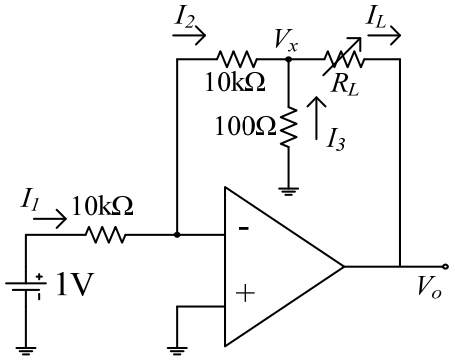

Fig. 1

3. The emitter follower in Fig. 2 is used to connect a source with R_{sig}=10 kΩ to a load R_L=1 kΩ. The transistor is biased at I=5 mA, utilizes a resistance R_B=40 kΩ, and has β=100 and V_A=100 V. (10%)
   (a) Find R_{ib}, R_{in}, G_v, G_{vo}, and R_{out}.
   (b) What is the largest peak amplitude of an output sinusoid that can be used without the transistor cutting off?

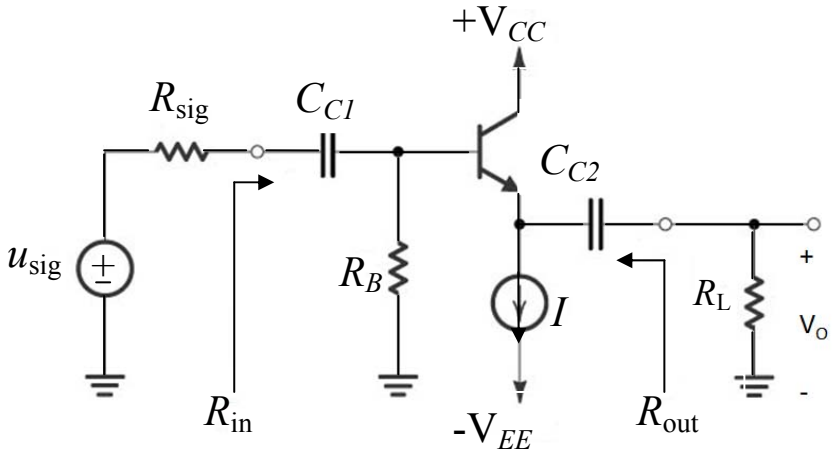

Fig. 2

4. For the Darlington voltage follower in Fig. 3：(10%)

   (a) Show that:

$$R_{in} = (\beta_1+1)[r_{e1}+(\beta_2+1)(r_{e2}+R_E)]$$

$$R_{out} = R_E \parallel \left[r_{e2} + \frac{r_{e1} + [R_{sig}/(\beta_1+1)]}{\beta_2+1}\right]$$

$$\frac{V_0}{V_{sig}} = \frac{R_E}{R_E + r_{e2} + \left[r_{e1} + R_{sig}/(\beta_1+1)\right]/(\beta_2+1)}$$

   (b) Evaluate R_{in}, R_{out}, and V_o/V_{sig} for the case I_{E2}=5mA, $\beta_1=\beta_2$=100, R_E=1kΩ, and R_{sig}=100kΩ.

$$V_{CC}$$

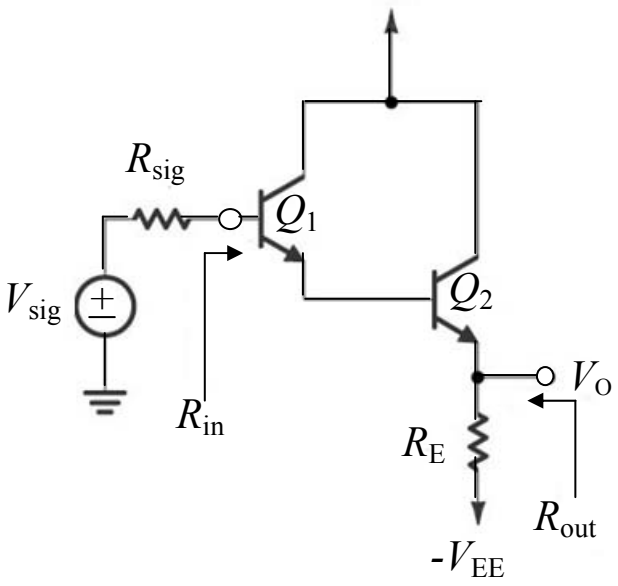

Fig. 3

5. Find V_E, V_{C1}, and V_{C2} in the circuit of Fig. 4. (10%)

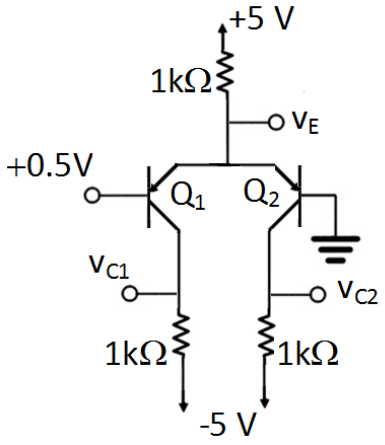

Fig. 4

6. The four MOS switches in Fig. 5 are driven by a non-overlapping two-phase clock. Show that the operation of the circuit of Fig. 5 during the two clock phases can realize a non-inverting switched-capacitor integrator. (10%)

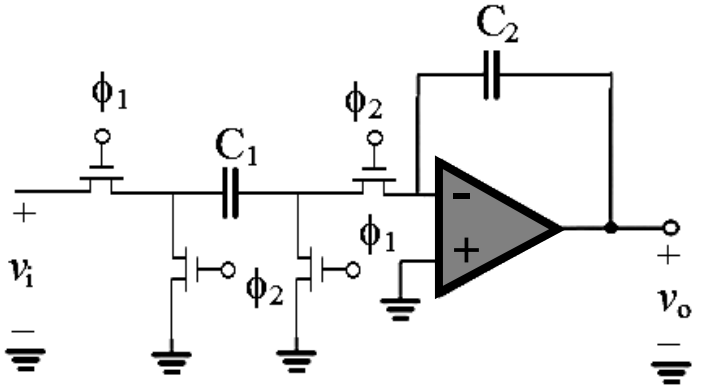

Fig. 5

7. For the Darlington voltage follower in Fig. 6, evaluate R_{in}, R_{out}, and V_o/V_{sig} for the case I_{E2}=5mA, $\beta_1=\beta_1$=100, R_E=1kΩ, and R_{sig}=100kΩ. (10%)

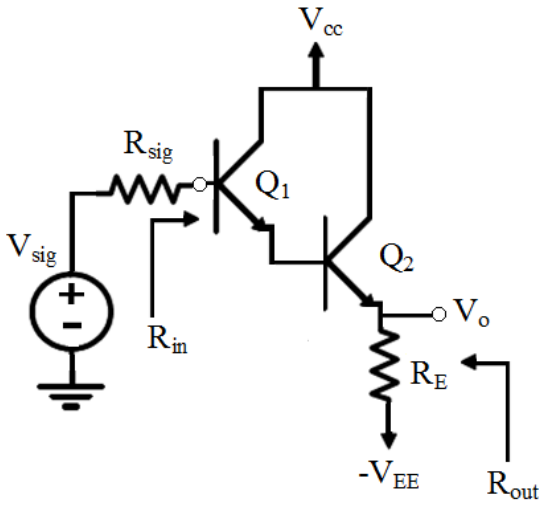

Fig. 6

8. A series-shunt feedback amplifier employs a basic amplifier with input and output resistance each of 1kΩ and gain A=2000 V/V. The feedback factor β=0.1 V/V. Find the gain A_f, the input resistance R_{if}, and the output resistance R_{of} of the closed-loop amplifier. (10%)

9. Consider a feedback amplifier for which the open loop gain $A(s)$ is given by

$$A(s) = \frac{1000}{(1+s/10^4)(1+s/10^5)^2}$$

If the feedback factor β is independent of frequency, find the frequency at which the phase shift is 180^0, and find the critical value of β at which oscillation will begin. (10%)