

國立成功大學  
110學年度碩士班招生考試試題

編 號： 121

系 所： 工程科學系

科 目： 電子電路

日 期： 0203

節 次： 第 1 節

備 註： 可使用計算機

※ 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. Mark each of the following statements True (T) or False (F). (Need NOT give reasons.) (20 pt.)

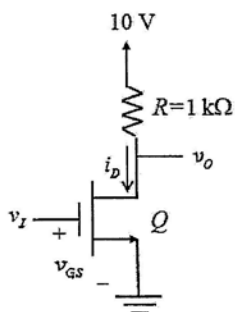
- (a) The current mirror must operate in the saturation region because it is used to amplify the signal source.
- (b) The large signal means the DC voltage.
- (c) We often cannot ignore the output resistance  $r_o$  of a transistor when analyzing an IC amp so that the voltages in intermediate nodes of an IC amp can be determined.
- (d) When performing AC (midband) analysis, the capacitors including coupling, bypass, and internal parasitic capacitors should be opened circuit because their impedances are zero.
- (e) Small-signal assumption makes the characteristics of transistors become linear.
- (f) Transistors of MOSFET and BJT are basically nonlinear devices.
- (g) The breakdown of typical diodes (except Zener diodes) is not considered because we must guarantee that the region is never entered.
- (h) Voltage buffers typically provide large gain, high input resistance, and low output resistance.
- (i) Analog signals are more convenient to process than digital signals.
- (j) The characteristics of amplifiers depend strongly on the DC operating point.

2. A new  $N$ -type transistor,  $Q$ , using the same symbol of the conventional NMOS, is the same as the conventional NMOS in all aspects except the following  $i_D - v_{GS}$  characteristics in the saturation region:

$$i_D = k(v_{GS} - V_t)^3$$

where  $k = 5 \text{ mA/V}^3$  is a constant, and  $V_t = 1 \text{ V}$  denotes the threshold voltage. Find the small-signal

voltage gain  $A_v \equiv \frac{v_o}{v_i}$  when  $V_t = V_{GS} = 2 \text{ V}$ . (20 pt.)



3. Figure 2 shows a circuit suitable for op-amp application. For all transistors  $\beta = 100$ ,  $V_{BE} = 0.7$  V,  $|V_T| = 25$  mV, and  $r_o = \infty$ . For dc analysis, you can ignore base currents and input dc voltages are zero. Calculate the gain of the amp with a load of  $10$  k $\Omega$  by ignoring (or open-circuit) the capacitor  $C$ . (20 pt.)

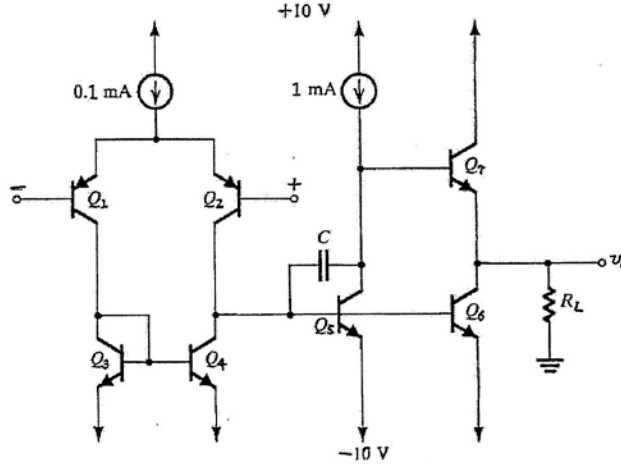
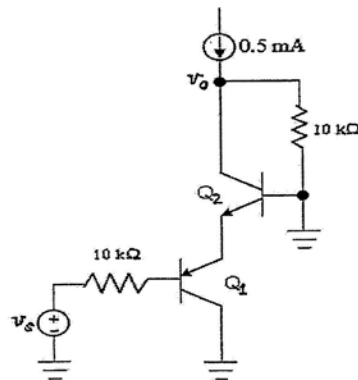


Figure. 2

4. The transistors are biased by a current source such that the transistors have  $\beta = 100$ ,  $r_\pi = 5$  k $\Omega$ ,  $g_m = 20$  mA/V,  $r_o = \infty$ . Find the gain of the amp. (20 pt.)



5. A commercial  $\mu$ A741 is employed in the noninverting configuration,  $R_1 = 1\text{ k}\Omega$  and  $R_2 = 9\text{ k}\Omega$ . The op amp has

its open-loop gain (or transfer function) as  $A(s) = \frac{10^4}{1 + \frac{s}{2\pi \times 100}}$ . If the input signal is  $0.1\sin(2\pi \times 100 \times 10^3 t)$ ,

that is, frequency=100 kHz and amplitude=0.1 V, obtain the output signal. (Note that  $1/\sqrt{2} = 0.707$ ) (20 pt.)

