

國立臺北大學 106 學年度學士班暨進修學士班轉學生招生考試試題

系別：電機工程學系 3 年級(學士班)

考試時間：80 分鐘

科目：電子電路

第 1 頁，共 2 頁

可 不可使用計算機

1. For a pn-junction in Fig. 1, explain (a) why are there free electrons (holes) on the n-side (p-side), (b) why are there positive (negative) ions on the n-side( p-side) of the depletion region. (10%)
2. Draw the small-signal model and prove the dc gain and -3dB frequency of the circuit in Fig. 2. (10%)
3.  $Q_1$ ,  $Q_{REF}$  and  $Q_F$  in Fig. 3 have the same current gain  $\beta$ .  $Q_1$  and  $Q_{REF}$  have emitter area  $n \cdot A_E$  and  $A_E$ , respectively. Assume that the collector current of  $Q_F$  is equal to its emitter current.  $I_{REF}$  is the input current, compute the output current  $I_{copy}$ ? (10%)
4. Determine the transfer function  $V_{out}(s)/V_{in}(s)$  of the circuit shown in Fig. 4, find the zero and pole frequency? (10%)
5. For the circuit shown in Fig. 5, the input current is  $I_{REF}$  that goes into N1. Applying the devices dimensions  $N1=(W/L)$ ,  $N2=2(W/L)$ ,  $N3=4(W/L)$ ,  $N4=8(W/L)$ ,  $N5=16(W/L)$ ,  $P1=(W/L)$ ,  $P2=2(W/L)$ , where  $W$  and  $L$  are channel width and length, respectively. What are the currents for N3 and N5, respectively? (10%)
6. Explain (a) drift current, (b) velocity saturation of electrons. (10%)
7. Define common-mode rejection ratio? What is the purpose to define it? (10%)
8. Why is the device dimension of BJT not shown in current  $I_C$  but the device dimension  $W/L$  is included in current  $I_D$  of MOSFET? (10%)  
 $(I_C=I_S \exp (V_{BE}/V_T), I_D=(1/2)(\mu_n C_{ox})(W/L)(V_{GS}-V_{TH})^2.)$
9. Explain (a) active saturation region of BJT, (b) saturation region of MOSFET. (Draw I-V curve and define the voltages that operates in the region.) (10%)
10. **Explain** Kirchhoff's Current Law(KCL) and Kirchhoff's **Voltage** Law(KVL). (10%)

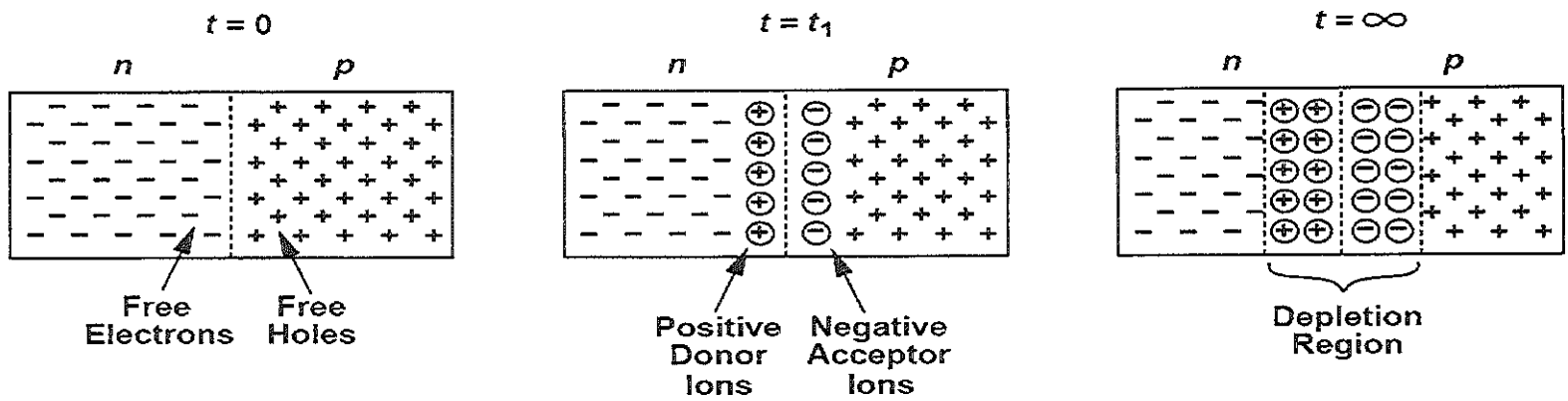


Fig. 1

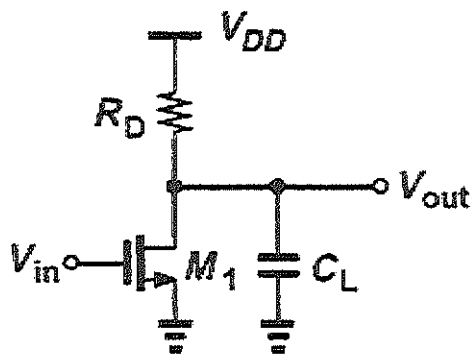


Fig. 2

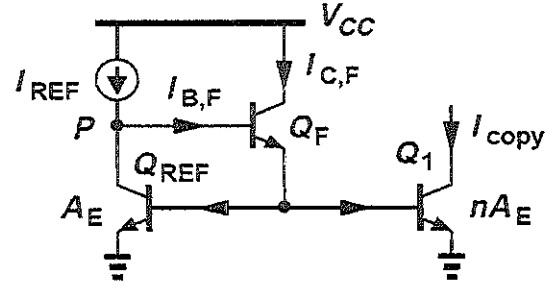


Fig. 3

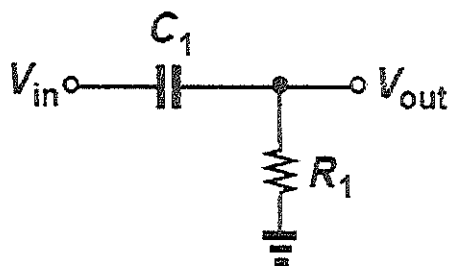


Fig. 4

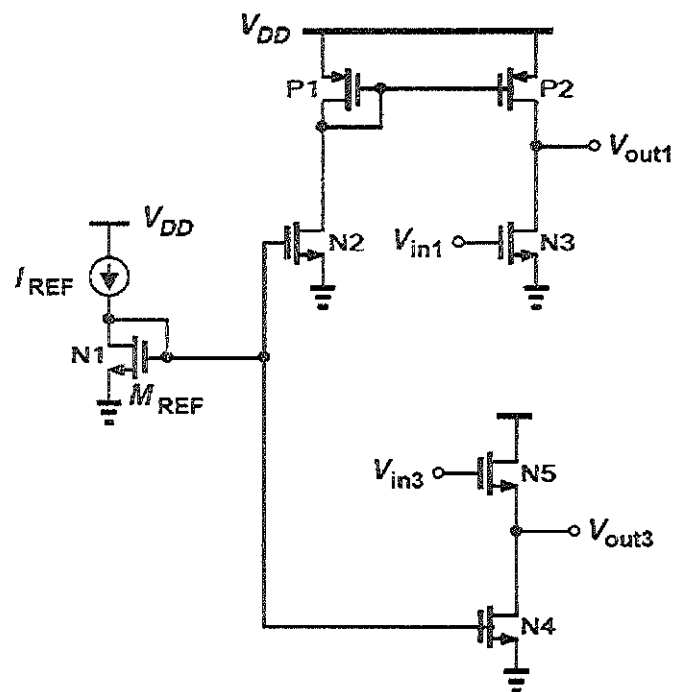


Fig. 5