

2020 松《电子技术A》

一、选择与填空

1. D

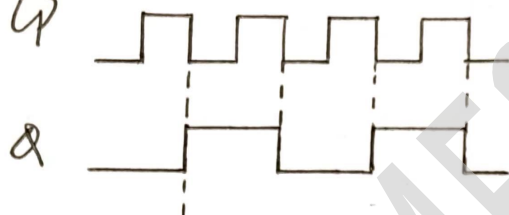
2. 饱和 截止 放大

3. B

4. ~~B~~ D

5. ~~4~~ 2

6. 4



$$\therefore U_i - (I_Z + I_0)R_1 - U_Z = 0$$

$$I_{Z\min} R_1 \quad R_1 = 322\Omega$$

$$I_{Z\max} R_1 \quad R_2 = 61\Omega$$

$$R \in (R_1 \sim R_2) \quad \text{选 } 330\Omega \times$$

$$\text{为使 } I_Z \text{ 稳定 使 } I_Z = \frac{70-5}{2} = 32.5\text{mA} \quad R_3 = 102\Omega$$

$$\therefore 100\Omega$$

选 200Ω , 200Ω 可以让
电阻功耗在 0.125W 以内

$$\begin{aligned} \approx 11) \quad U_B &= \frac{R_{B2}}{R_{B1} + R_{B2}} U_{CC} \\ &= \frac{22}{73} \times 12 \\ &= 3.616 \text{ V} \end{aligned}$$

$$\begin{aligned} I_C \approx I_E &= \frac{U_B - U_{BE}}{R_E' + R_E} \\ &= \frac{3.616 - 0.7}{2000} \\ &= 1.458 \text{ mA} \end{aligned}$$

$$\begin{aligned} I_B &= \frac{I_C}{\beta} \\ &= \frac{1.458 \times 10^{-3}}{50} \\ &= 0.029 \text{ mA} \end{aligned}$$

$$\begin{aligned} U_C &= U_{CC} - I_C \cdot R_C \\ &= 12 - 2 \times 1.458 \\ &= 9.084 \text{ V} \end{aligned}$$

$$\begin{aligned} U_{CE} &= U_C - U_E \\ &= 9.084 - 2.916 \\ &= 6.168 \text{ V} \end{aligned}$$

$$U_E = U_B - U_{BE} = 2.916 \text{ V}$$

$$\begin{aligned} \therefore I_B &= 0.029 \text{ mA} \\ I_C \approx I_E &= 1.458 \text{ mA} \\ U_{CE} &= 6.168 \text{ V} \end{aligned}$$

A). 电压增益式的大电阻

$$\begin{aligned} r_i &= \frac{U_i}{I_i} = R_{B1} \parallel R_{B2} \parallel (r_{be} + (\beta + 1)R_E') \\ &= \frac{22 \times 51}{73} \times 10^3 \parallel 11.2 \times 10^3 \\ &= 6.48 \text{ k}\Omega \end{aligned}$$



$$\begin{aligned} \therefore r_i &= 6.48 \text{ k}\Omega \\ r_o &= 2 \text{ k}\Omega \end{aligned}$$

$$r_o = \frac{U_o}{I_o} = R_C = 2 \text{ k}\Omega$$

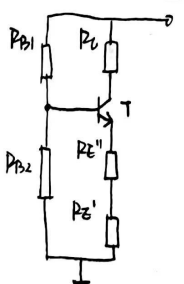
$$A_u = -\frac{\beta(R_C \parallel R_L)}{r_{be} + (\beta + 1)R_E'} = -\frac{50 \times 1 \times 10^3}{1 \times 10^3 + 51 \times 200} = -4.464$$

$$A_{us} = \frac{r_i}{r_i + R_s} A_u = \frac{U_o}{U_s} = -4.464 \times \frac{6.48}{6.48 + 0.6} = -4.086$$

$$U_o = A_{us} U_s = -4.086 \times 10 \text{ mV} = -40.86 \text{ mV}$$

$$U_o = -40.86 \text{ mV}$$

14)



U_B 由于 R_{B1} R_{B2} 分压 相对固定
当 U_{BE} 引起 I_B 上升, 则 I_C I_E 上升
 U_E 上升, $U_B - U_E$ 下降 从而 I_B 下降
使静态工作点 I_B I_C U_{CE} 稳定

(5). 电流串联负反馈

= 减小放大倍数
提高放大电路的稳定性
减小非线性失真
展宽通频带

四、(12分)如图所示电路中，输入信号 u_i 为矩形波，设运放为理想运放，在 $t=0$ 时电容器两端的初始电压为零。求：

(1) 写出 u_{o1} 和 u_o 的表达式。

(2) 画出 u_{o1} 和 u_o 的波形，要求与输入波形对应。

13)

A_1 有负反馈 线性区

$$i_{-1} = i_{+1} = 0 \quad u_{-1} = u_{+1} = 0$$

$$i_1 = \frac{u_i - 0}{R_1}$$

$$0 - u_{o1} = \frac{1}{C} \int i_1 dt$$

$$u_{o1} = -\frac{1}{R_1 C} \int u_i dt$$

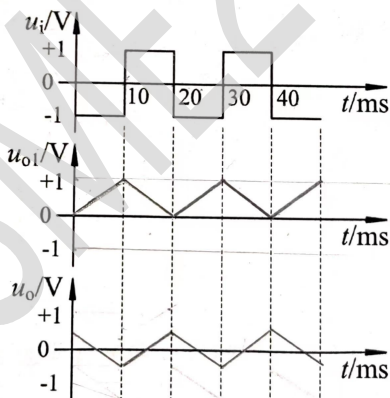
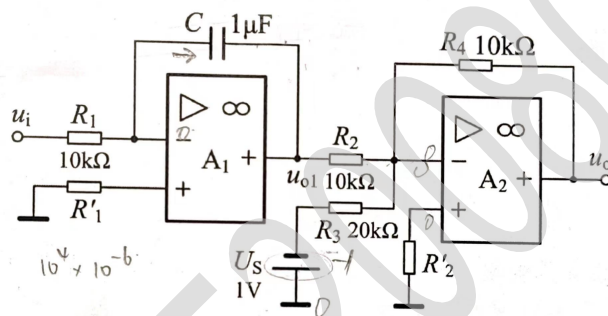
A_2 有负反馈 线性区

$$i_{-2} = i_{+2} = 0 \quad u_{-2} = u_{+2} = 0$$

$$i_2 = \frac{u_{o1} - 0}{R_2} \quad i_3 = \frac{U_S - 0}{R_3}$$

$$0 - u_o = R_4 (i_2 + i_3)$$

$$u_o = -u_{o1} + 0.5$$



$$u_i = 1 \quad t \in (0, 10)$$

$$u_i = -1 \quad t \in (10, 20)$$

$$u_i = 1 \quad t \in (20, 30)$$

$$u_i = -1 \quad t \in (30, 40)$$

$$u_i = 1 \quad t \in (40, 50)$$

$$u_i = -1 \quad t \in (50, 60)$$

$$u_i = 1 \quad t \in (60, 70)$$

$$u_i = -1 \quad t \in (70, 80)$$

五: $U_{omax} = 12V$

$U_{omin} = 0$

D_1 导通条件: $U_o > U_{o1}$

D_2 导通条件: $U_o > U_{o2}$

$$\begin{cases} U_o > 0, & U_o = 6V \\ U_o < 0, & U_o = 0 \end{cases}$$

$U_i = U_{i-} = U_{i+}$

$i_- = i_+ = 0$

$$\begin{cases} U_{i-} = \frac{R_3 \times 15}{R_1 + R_2 + R_3} = 1V \\ U_{i+} = 5V \end{cases}$$

① $0 < U_i < 1V$, $U_{o1} = 12V$, $U_{o2} = 0$

全 D_1, D_2 开路

$U_o = 6V$, $U_o < U_{o1}$, D_1 截止

$U_o > U_{o2}$, D_2 导通

U_o 迅速变为 $0.7V$, VD_2 截止

② $1V < U_i < 5V$, $U_{o2} = 12V$, $U_{o1} = 12V$

全 D_1, D_2 开路, $U_o = 6V$

$U_o < U_{o1}$, $U_o < U_{o2}$, D_1 和 D_2 均截止, 则 $U_o = 6V$

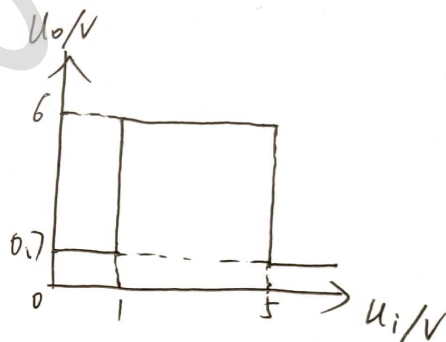
③ $U_i > 5V$, $U_{o1} = 0V$, $U_{o2} = 12V$

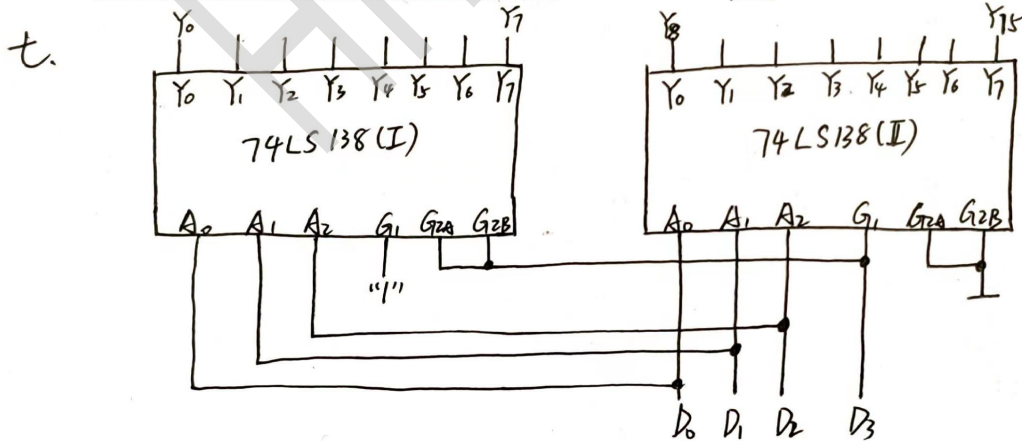
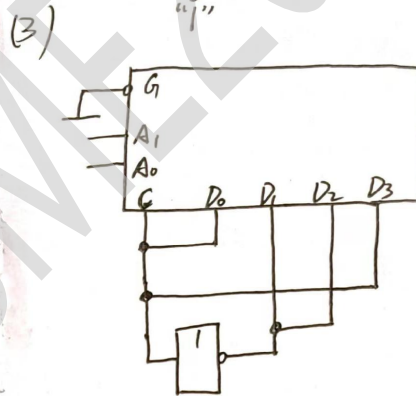
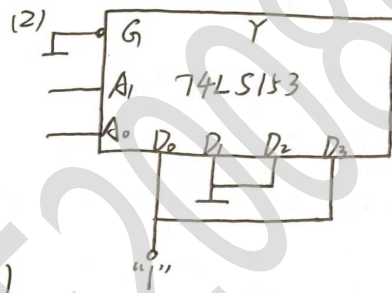
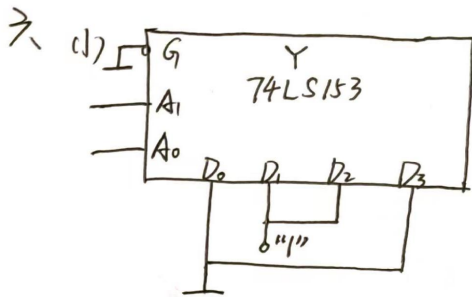
全 D_1, D_2 开路, $U_o = 6V$

$U_o > U_{o1}$, $U_o < U_{o2}$

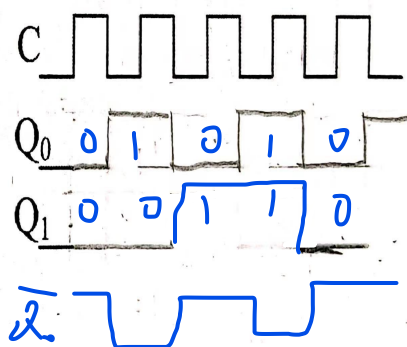
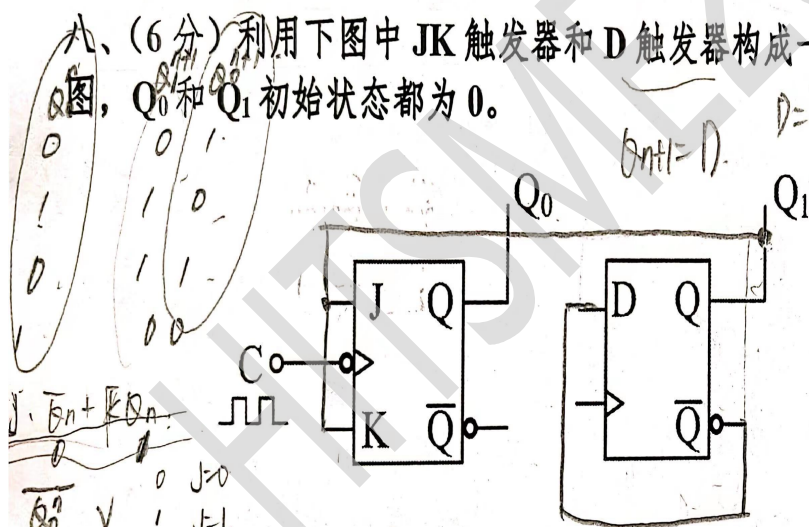
D_1 导通, D_2 截止

$U_o = 0.7V$, VD_2 即刻截止





九、(6分) 利用下图中 JK 触发器和 D 触发器构成一个两位二进制加法计数器，并画出波形图， Q_0 和 Q_1 初始状态都为 0。



00 01
01 10
10 11
11 00

$J = \bar{Q}_n + K Q_n$
 $\bar{Q}_n$ V 0 J=0
 1 J=1
 1 K=0

R, C 值
(1) $f = f_0 = \frac{1}{2\pi RC} = 159.155 \text{ Hz}$

(2) D_1, D_2 中有一个导通

二极管导通时

$$|F| = \frac{V_f}{V_o} = \frac{1}{3}$$

$$|A| = \frac{V_o}{V_i} = 3$$

右图是同相比例

$$A = 1 + \frac{R_f}{R_1} = 3$$

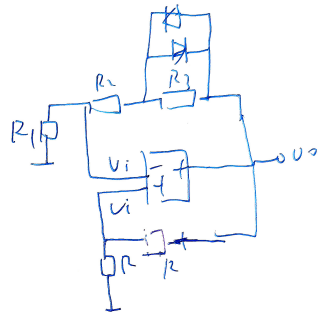
$$R_f = 2R_1 = 10 \text{ k}\Omega$$

$$R_3 \parallel R_D \parallel R_{D2} = R_f - R_2 = 1 \text{ k}\Omega$$

(3) $A = \frac{V_o}{V_i} = 3 = \frac{10.5}{3.5} \Rightarrow V_o = 3.5 \text{ V}$ **10.5**

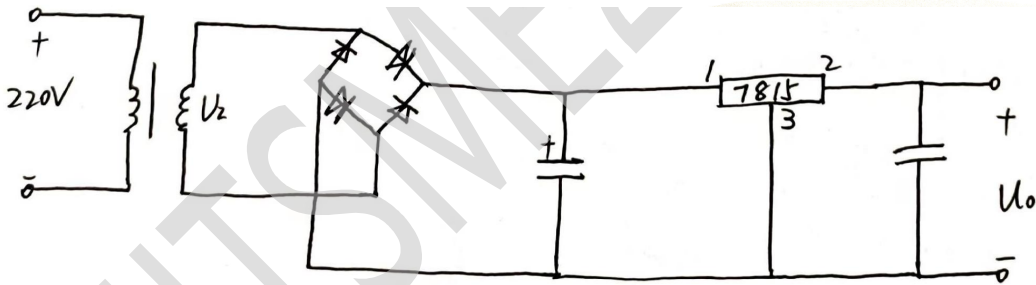
= 电压 0.7V

$$R_2 = 0.789 \text{ V}$$



九略

十.



$$U_o = 15 \text{ V}$$

$$U_{B3} = U_o + 3 \text{ V} = 18 \text{ V} = 1.2 U_2$$

$$U_2 = 15 \text{ V}$$

$$U_{RM} = \sqrt{2} U_2 = 42.4 \text{ V}$$

21.2 V