HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Course：Electronic Circuit（A CLOSED BOOK 2014）

CLASS： _____ **NAME：** _____ **No.** _____

No..	1	2	3	4	5	6	7	8	Final
Full mark	10	6	10	15	16	18	15	10	100
Score									

Score	

1.（**10 points**）

For the circuit in Figure 1, assume all the op-amps are ideal, and v_{I1}=0.004V, v_{I2}=0.2V. Determine the output voltage v_{O1}, v_{O2}, v_{O3}, v_{O4}, v_O.

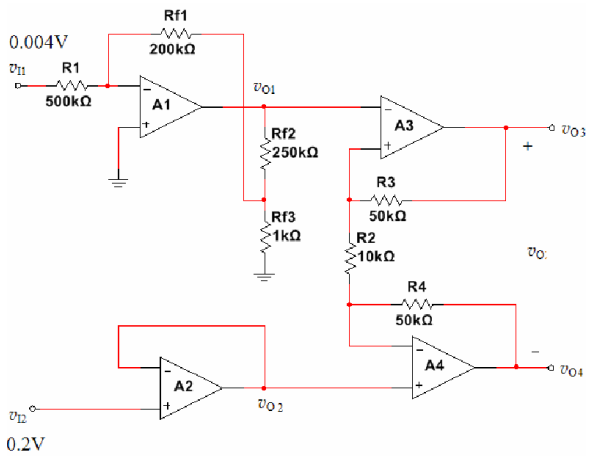


Figure 1

Score	

2.（6 points）

The circuit structure in Figure 2 is obtained by testing an amplifier, but the transistor type has been unable to see. It may be BJT, may also be FET. Sketch at least two possible symbols of the transistor（The corresponding pin positions to be marked）

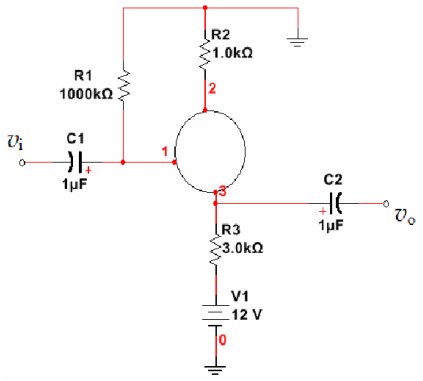
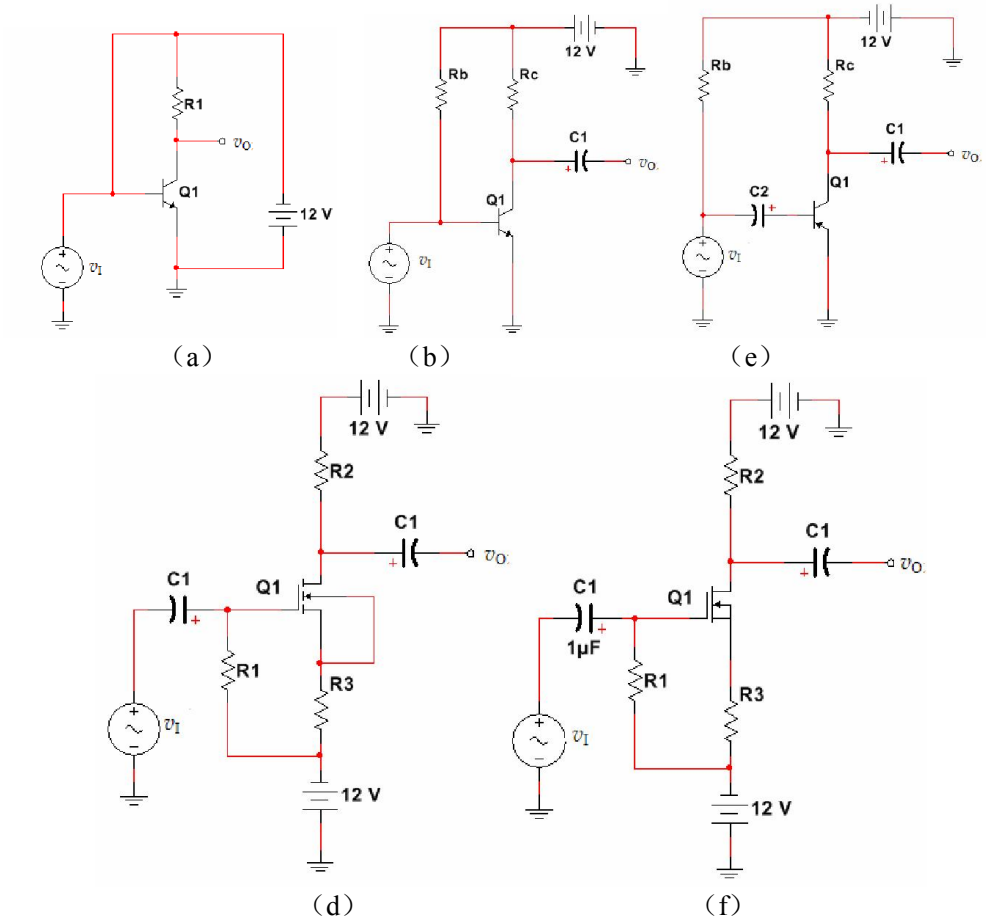


Figure 2

Score		

3.（10 points）

For the circuits in Figure 3, all the capacitors are assumed to act as short circuits for ac small signal. Determine the circuit can amplify sinusoidal ac signal or not, and you must give the reasons.



（a） （b） （e）

（d） （f）

Figure 3

Score		

4.（15 points）

Consider the circuit in Figure 4, the transistor parameters are V_{TN}=0.8V, K_n=1mA/V^2, and λ=0.When in saturation region, $I_D = K_n(V_{GS} - V_{TN})^2$,when in nonsaturation, $I_D = 2K_n(V_{GS} - V_{TN})V_{DS}$.

1) Find the V_{GSQ}, I_{DQ}, V_{DSQ};
2) Sketch the small-signal equivalent circuit;
3) Find the small-signal voltage gain A_v=v_o/v_i;
4) Find the input resistance R_i and output resistance R_o.

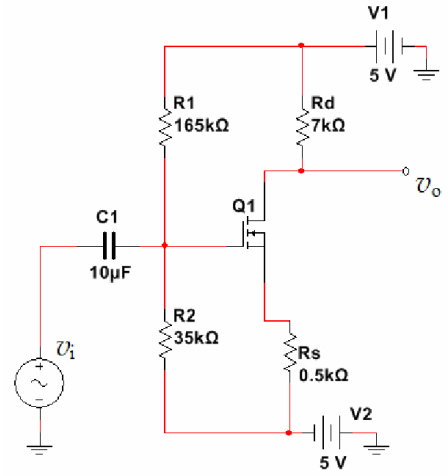


Figure 4

Score		

5.（16 points）

For the circuit shown in Figure 5, the transistors Q1、Q2；Q3、Q4；Q5、Q6 are identical, and for each transistor $V_{BE(on)}$ = 0.7V, r_π=1kΩ, β=100, and the quiescent currents are I_{C1}=0.2mA, I_{C9}=1.5mA, when v_i=0, v_o=0.

1) Find the value of the resistor $R1$ and $R3$;

2) Find the output resistance R_o;

3) If $R4$=10kΩ, find the voltage gain A_v=$\triangle v_o/\triangle v_i$;

4) If $R4$=8Ω, and the saturation voltage of the transistors Q8 and Q9 is negligible, find the maximum power of the load R4.

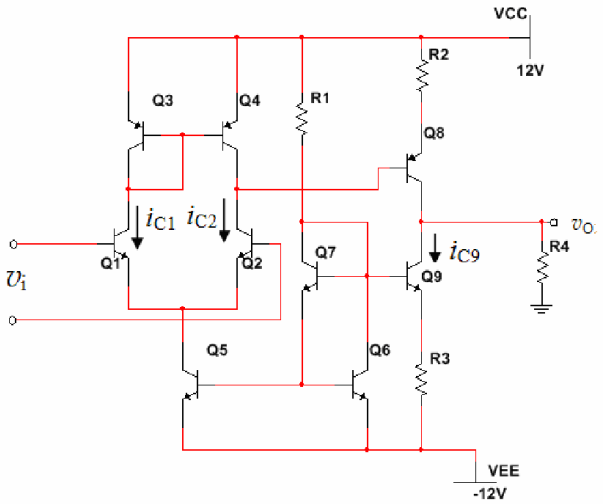


Figure 5

6.（18 points）

For the circuit shown in Figure 6.

1) If want to reduce the output resistance, connect the feedback resistor R_f to get negative feedback, and determine the feedback configuration and polarities, if $|1+A\beta|>>1$，calculate the closed-loop voltage gain;

2) If want to increase the input resistance, connect the feedback resistor R_f to get negative feedback, and determine the feedback configuration and polarities, if $|1+A\beta|>>1$，calculate the closed-loop voltage gain.

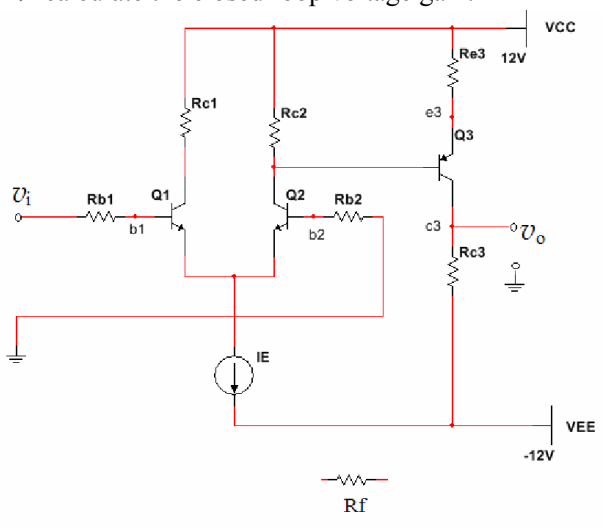


Figure 6

Score	

7.（15 points）

For the circuit in Figure 7, assume A1 and A2 are ideal.

1）In order to meet the conditions of circuit to start oscillation, label the noninverting and inverting input terminal of the operational amplifier A1 with the sign of “+” and “-” in the figure;

2）Determine the oscillating frequency;

3）Explain the function of the diodes D1 and D2;

4）If the peak value of v_{O1} is equal to 6V, and the Zener diode voltage of D3 and D4 is V_Z=6V, sketch the corresponding waveform of v_O.

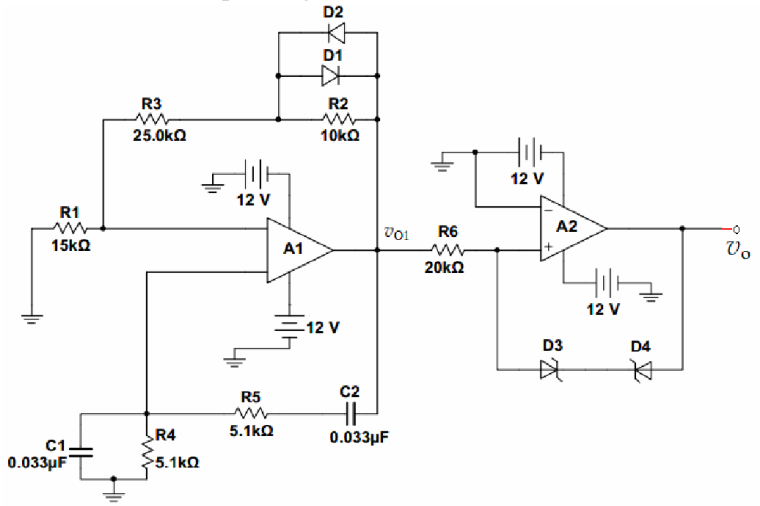


Figure 7

Score	

8.（10 points）

For the circuit in the Figure 8.

1）Label the noninverting and inverting input terminal of the operational amplifier A1 with the sign of “+” and “-” in the figure;

2） When $R_3=R_p=R_4=300\Omega$，for the Zener diode $V_{Z1}=6\text{V}$，determine the value range of the output voltage V_o.

3） Determine the current I_{E3} of the transistor T3.

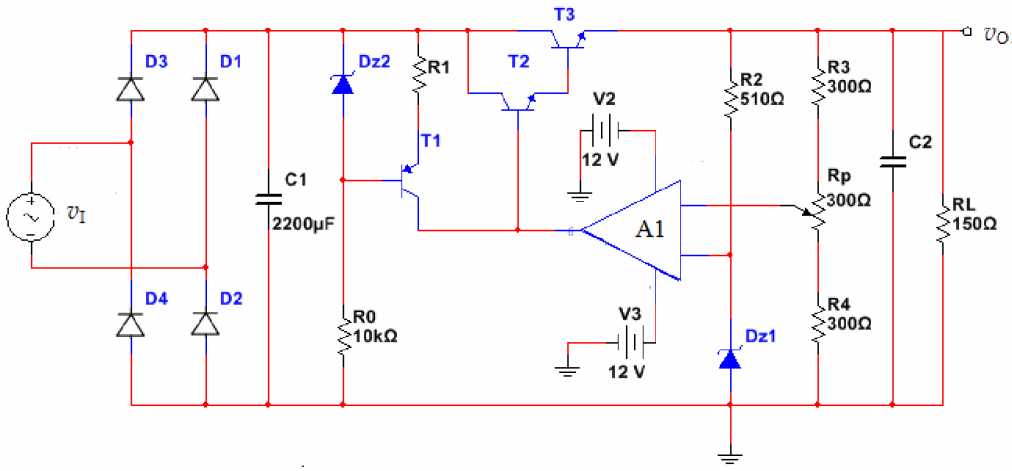


Figure 8

Vocabulary:

Sketch	画出
equivalent circuit	等效电路
input resistance	输入电阻
voltage gain	电压增益
current gain	电流增益
output resistance	输出电阻
bipolar transistor	双极型晶体管
parameter	参数
differential-mode	差模
derive	推导
expression	表达式
feedback circuit	反馈电路
feedback configuration	反馈结构
polarities	极性
label	标出
instantaneous polarities	瞬时极性
closed-loop	闭环
wave-generating	波形产生
Zener diodes	稳压二极管
neglecting	忽略
the forward voltage	正向电压
waveform	波形
qualitatively	定性地
voltage regulator	稳压器
noninverting	同相
inverting	反相

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