明新科技大學 102 學年度研究所考試入學招生 試題卷

系所類別	科目	節次	准考證號碼(考生請填入)	考試日期
電機工程系碩士班（電機組）	電子學	第一節		102/4/28

※答案須寫在答案卷內，否則不予計分。

1. Assume that the diodes, in the forward bias condition, can be modeled as a constant voltage drop V_D=0.7V in series with an equivalent resistance r_D=20Ω. Design R and calculate I_D as shown in Fig. 1 to provide Vo=1.6 V. (10%)
2. Considering the ideal operational amplifier circuit shown in Fig. 2, find the expression of v_o in terms of v_1 and v_2. (10%)

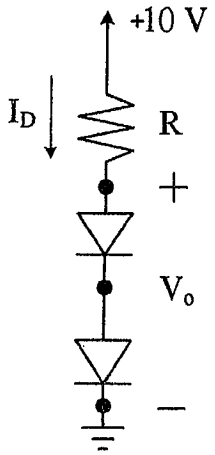

Fig. 1

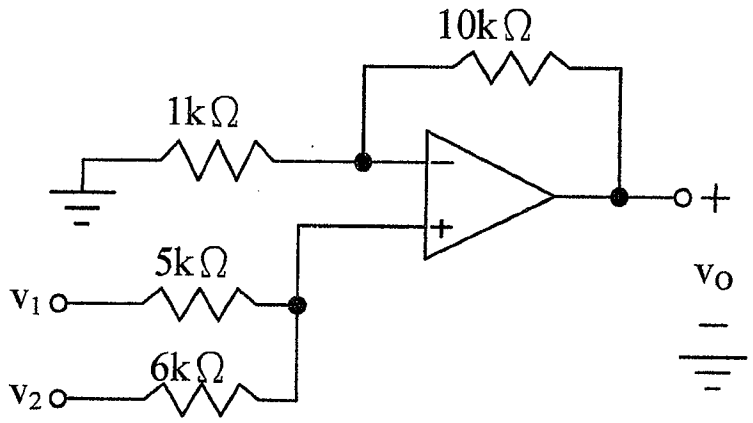

Fig. 2

3. The inverting opamp circuit shown in Fig. 3 has output saturation voltages=±15V. The other parameters of the opamp are assumed to be ideal and R1=10kΩ, R2=50kΩ.
   (a) When Vi(t)=0.3sin(2000πt), plot the waveform of Vo(t) for at least one cycle. (5%)
   (b) When Vi(t)=4sin(2000πt), plot the waveform of Vo(t) for at least one cycle. (5%)
4. Fig. 4 is a simple opamp circuit with its output saturation voltages=±15V and differential voltage gain Av=10000(V/V). The other parameters of the opamp are assumed to be ideal.
   (a) When Vi=1mV, find the value of Vo. (5%)
   (b) When Vi=100mV, find the value of Vo. (5%)

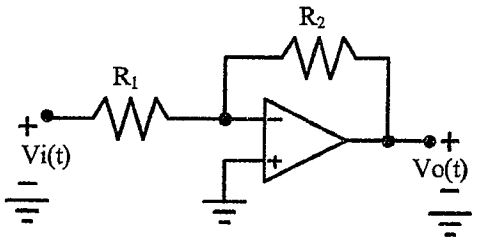

Fig. 3

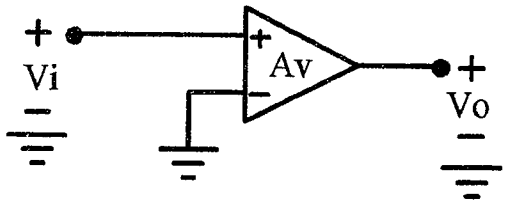

Fig. 4

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5. For the circuit shown in Fig. 5, derive its transfer function $V_o(S)/V_I(S)$. If R=1KΩ and C=0.1μF, find its -3dB bandwidth ω_{BW}(rad/sec) for the circuit. (10%)

6. For the circuit shown in Fig. 6, assume that NPN transistor has β=50 and BE forward bias voltage V_{BE}=0.7V. Find the values of I_C, I_E, V_B, V_C, and V_E. (10%)

7. Fig. 7 shows a simple NMOS circuit with $(\mu_n C_{ox})(W/L)$=2mA/V^2 and V_{th}=1.0V. Assume that an NMOS in saturation region has: $I_D=0.5(\mu_n C_{ox})(W/L)(V_{GS}-V_{th})^2$,

and in triode region has: $I_D=(\mu_n C_{ox})(W/L)[(V_{GS}-V_{th})V_{DS}-0.5V_{DS}^2]$.

When V_G=1.5V, determine the values of V_{GS}, and I_D. (10%)

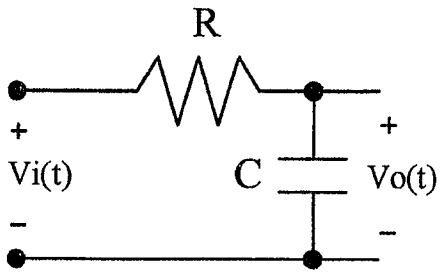

Fig. 5

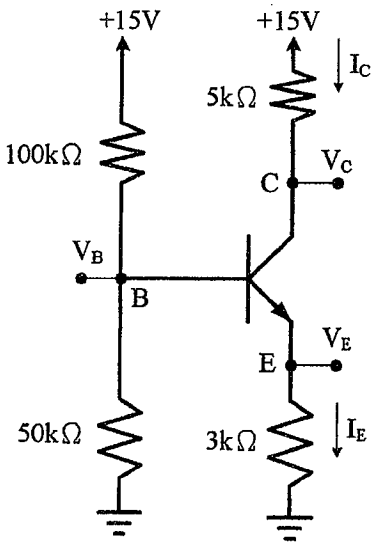

Fig. 6

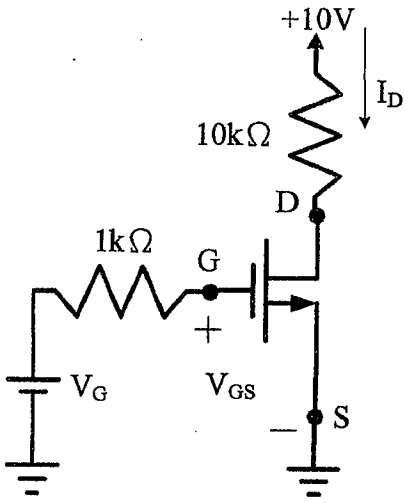

Fig. 7

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8. For the current mirror circuit in Fig. 8 with $V_{DD}=V_{SS}=5V$, two enhancement NMOSFETs Q1 and Q2 have equal channel length and width with $(\mu_n C_{ox})(W/L)=1mA/V^2$ and $V_{th}=1.0V$. Assume that an NMOS in saturation region has $I_D=0.5(\mu_n C_{ox})(W/L)(V_{GS}-V_{th})^2$. Find the value of R to obtain $I_{D2}=0.5mA$ as Q2 operates in the saturation region. (10%)
9. According to the circuit shown in Fig. 9, the NMOSFET with $V_{th}=1.5V$ and $(\mu_n C_{ox})(W/L)=1mA/V^2$. If its small signal parameter $gm=(\mu_n C_{ox})(W/L)(V_{GS}-V_{th})$, find the values of V_{GS} and gm. (10%)
10. The Common Source amplifier shown in Fig. 10 is connected to a signal source v_{sig} with $R_{sig}=100k\Omega$ and a load resistance $R_L=15k\Omega$. Assume that the NMOSFET is properly biased in the saturation region and has the following small signal parameters $g_m=1mA/V$ and $r_o=150k\Omega$. Find the overall voltage gain $A_v=v_o/v_{sig}$. (10%)

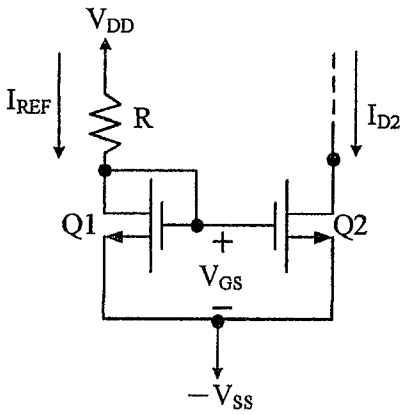

Fig. 8

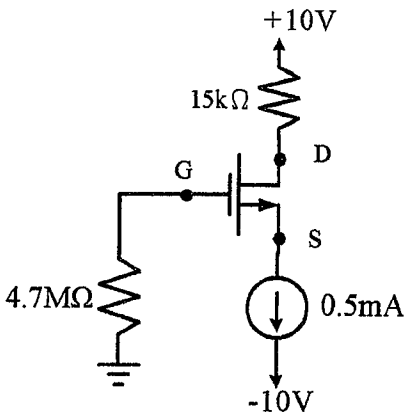

Fig. 9

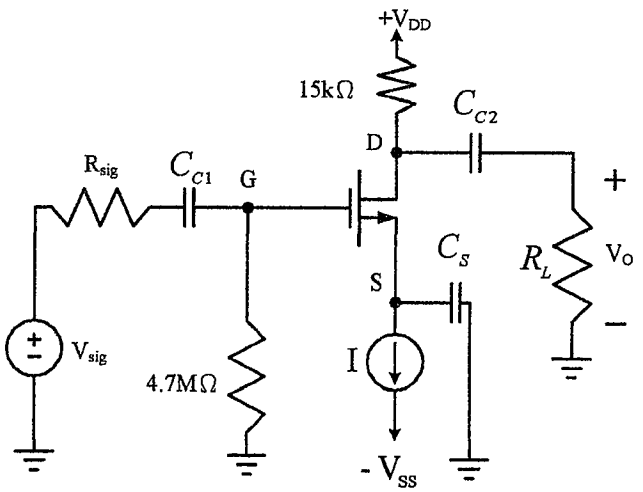

Fig. 10