國立臺南大學 102 學年度 **電機工程學系碩士班** 招生考試 電子學 試題卷

1. Suppose the solar irradiation Q_1 is higher than Q_2. Draw the *V-I* characteristic curves of a silicon-based solar cell under the irradiations Q_1 and Q_2.

   (10 Points)

2. (a) An differential OPA circuit is shown in Fig. 1. OPA is ideal. Draw the waveform of output signal v_o if the input signal of the circuit is defined as $v_i = \sin 314t$ (volt). （波形圖請標明座標軸之刻度）

   (10 Points)

   (b) Similarly, another OPA circuit is shown in the Fig 2, where all OPA and diodes are ideal. Draw the waveform of output signal v_o if the input signal of the circuit is given as $v_i = \sin 314t$ (volt). （波形圖請標明座標軸之刻度）

   (10 Points)

   (c) The band-pass amplifier in Fig. 3 has $\boldsymbol{f_L}$= 150Hz, $\boldsymbol{f_H}$=180Hz, and $\boldsymbol{A}$=10. If the input signal of amplifier is given by $v_i = \sum_{h=1}^{25} \frac{3}{h} \sin(314ht)$ (volt). Find the mathematic expression of the output signal. (10 Points)

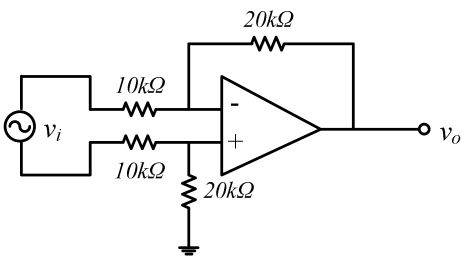

Fig. 1

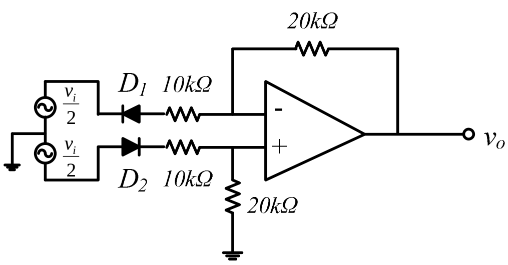

Fig. 2

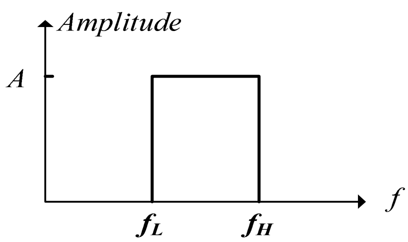

Fig. 3

3. Use the Feedback method to find the voltage gain V_0/V_S, the input resistance R_{in}, and the output resistance R_{out} of the inverting op amp configuration of Fig. 4. (assume the op amp has open-loop gain $\mu=10^4$, R_{id} =100 KΩ, $R_{icm}\rightarrow\infty$, and r_0 =1KΩ.) (10 Points)

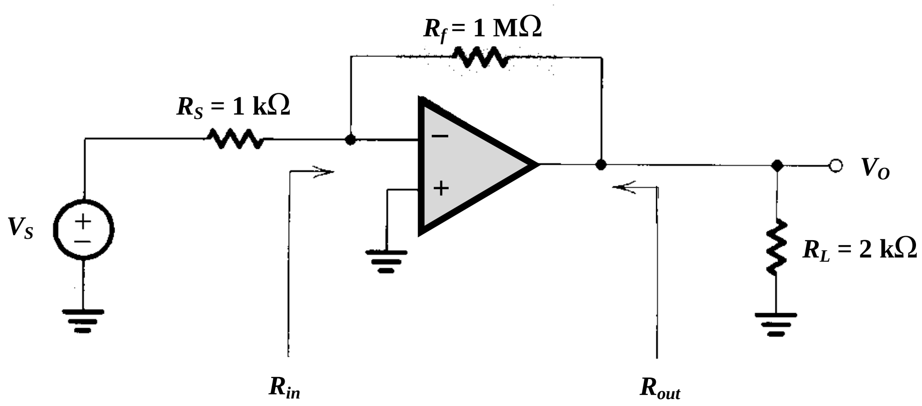

Fig. 4

4. For the circuits in Fig. 5(a)-(c), $\mu_n C_{ox}=2.5\ \mu_p C_{ox}=20\ \mu A/V^2$, $|V_t|=1V$, neglect the channel-length modulation effect, L=10 μm, and W=30 μm, unless otherwise specified. Find the labeled currents (I_1, I_3, I_6) and voltages (V_2, V_4, V_5). (10 Points)

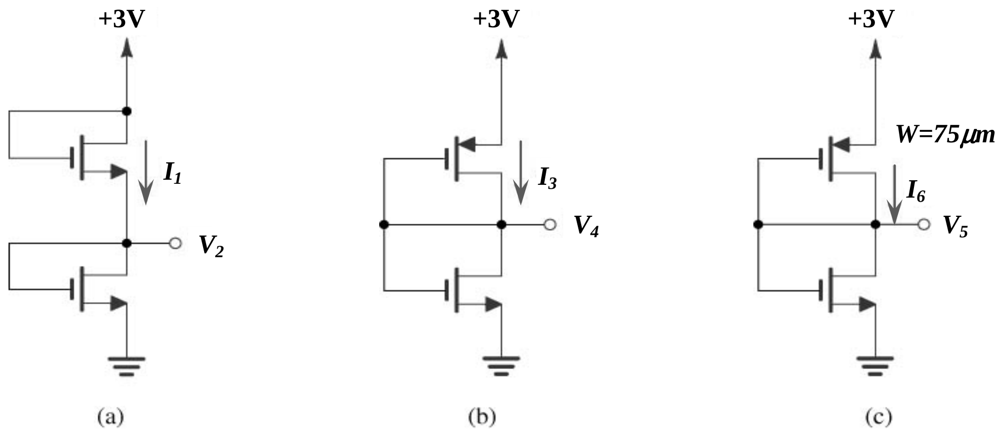

Fig. 5

5. The emitter follower in Fig. 6 is used to connect a source with R_{sig}=10 kΩ to a load R_L=1 kΩ. The transistor is biased at I=5 mA, utilizes a resistance R_B=40 kΩ, and has β=100 and V_A=100 V.
   (a) Find R_{in}, G_v, G_{vo}, and R_{out}.
   (b) What is the largest peak amplitude of an output sinusoid that can be used without the transistor cutting off?
   (c) If in order to limit nonlinear distortion the base-emitter signal voltage is limited to 10 mV peak, what is the corresponding amplitude at the output?
   (d) What will the overall voltage gain become if R_L is changed to 2 kΩ?

(20 Points)

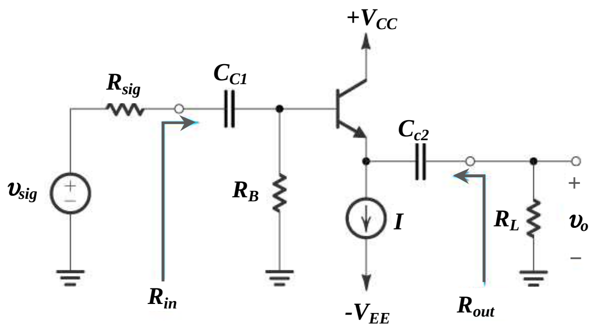

Fig. 6

6. Fig. 7 shows a cascode MOS mirror utilizing devices with V_t=0.5V, $\mu_n C_{ox}$=387μA/V^2, V_A=5V/μm, W/L=3.6μm/0.36μm, and I_{REF}=100μA. Find the minimum dc voltage required at the output and the output resistance. (10 Points)

7. An active-loaded MOS differential amplifier of the type shown in Fig.8 is specified as follows: $(W/L)_n$=100, $(W/L)_p$=200, $\mu_p C_{ox}$=0.2mA/V^2, V_{An}=|V_{Ap}|=20V, I=0.8mA, R_{SS}=25kΩ. Calculate G_m, R_o, A_d, $|A_{cm}|$, and $CMRR$. (10 Points)

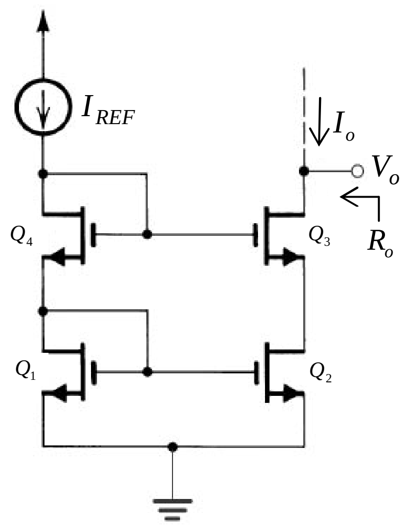

Fig. 7

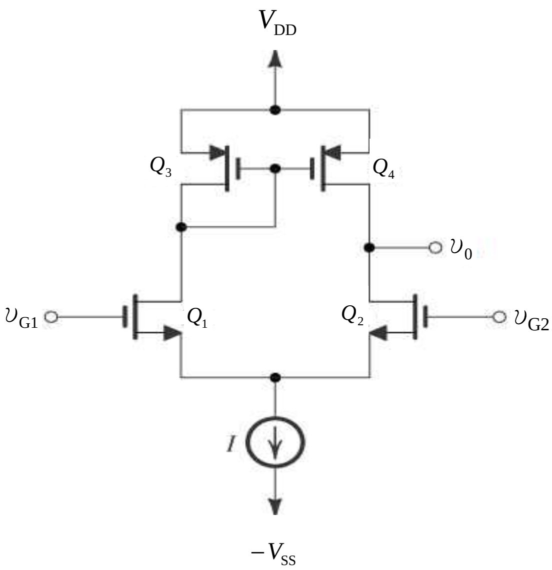

Fig. 8