編號： 187、205　　國立成功大學 106 學年度碩士班招生考試試題

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考試科目：電子學　　考試日期：0213，節次：1

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. As shown in Fig. 1, the op amp has V_{OS}=4 mV and the output saturation voltages of ±12 V. Consider a Miller integrator with a time constant of 1 ms and R=20 kΩ
   (a) Assume that, when the power supply is turned on, the capacitor voltage is zero, how long does it take for the amplifier to saturate (neglected R_F)? (4%)
   (b) Select the largest possible value for a feedback resistor R_F so that at least ±10 V of output signal swing remains available. (4%)
   (c) What is the corner frequency of the resulting single-time constant (STC) network? (4%)

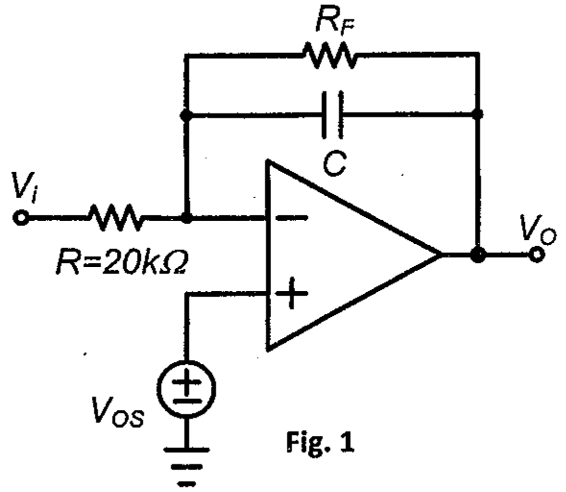

Fig. 1

2. The op amp in the precision rectifier circuit of Fig. 2 (a) is ideal with output saturation levels of ±13 V. Assume that when conducting the diode exhibits a constant voltage drop of 0.7 V.
   (a) V_I=+3V, find V_O and V_A ? (4%)
   (b) V_I=-1V, find V_O and V_A ? (4%)
   (c) Find the average output voltage obtained when V_I is a symmetrical square wave of 1-kHz frequency, 5-V amplitude, and zero average as shown in Fig. 2(b) (4%)

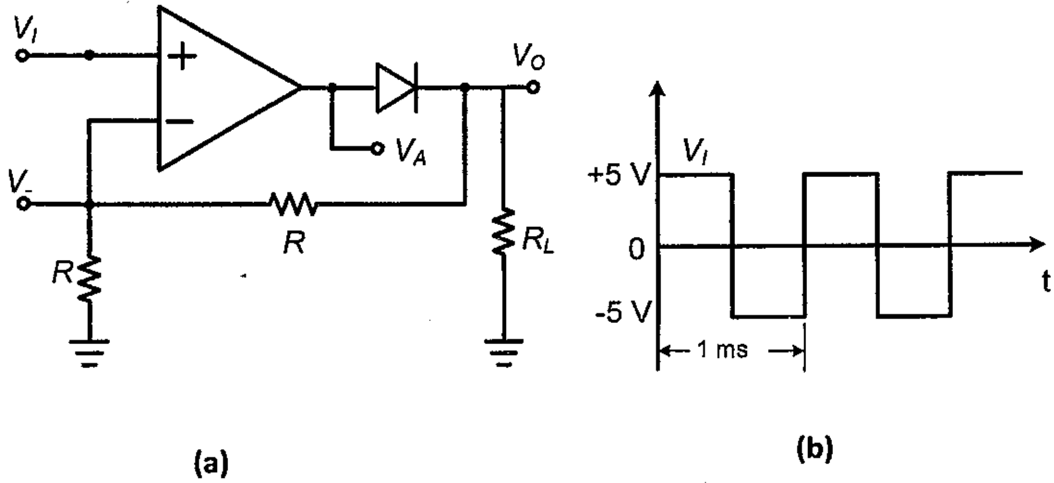

Fig. 2

3. As shown in Fig. 3, an IC CG amplifier is fed from a signal source with $R_{sig}=r_o/2$, where r_o is the MOSFET output resistance. It has a current-source load with an output resistance equal to r_o. The MOSFET is operated at $I_D=100$ μA and has $g_m=1.5$ mA/V, $V_A=10$ V, $C_{gs}=0.2$ pF, $C_{gd}=15$ fF, $C_{db}=20$ fF, and $C_L=30$ fF (neglected body effect).
   (a) Determine the input resistance, R_{in} (4%)
   (b) Find the output resistance, R_{out} (4%)
   (c) Find the midband gain, $A=V_o/V_{sig}$ (4%)
   (d) Find the upper 3-dB frequency, f_H, using the method of open-circuit time constant (4%)

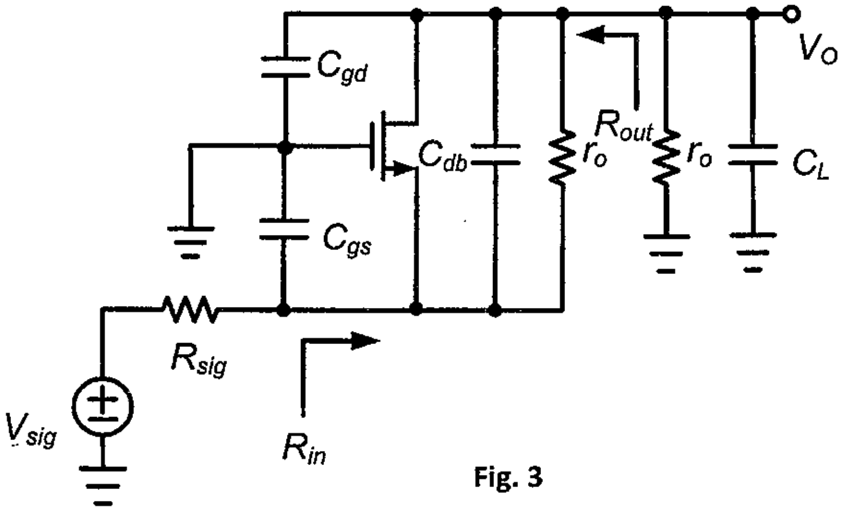

Fig. 3

4. Considering the multi-stage amplifier with feedback as shown in Fig. 4, if all three MOSFETs are biased to operate at $g_m=4$ mA/V. You may neglect their r_o's (channel-length modulation effect)
   (a) Select a value for R_F that results in a closed-loop gain that is ideally 10 V/V (3%)
   (b) Determine the loop gain, Aβ (4%), and hence the value of closed-loop gain, A_f (3%)

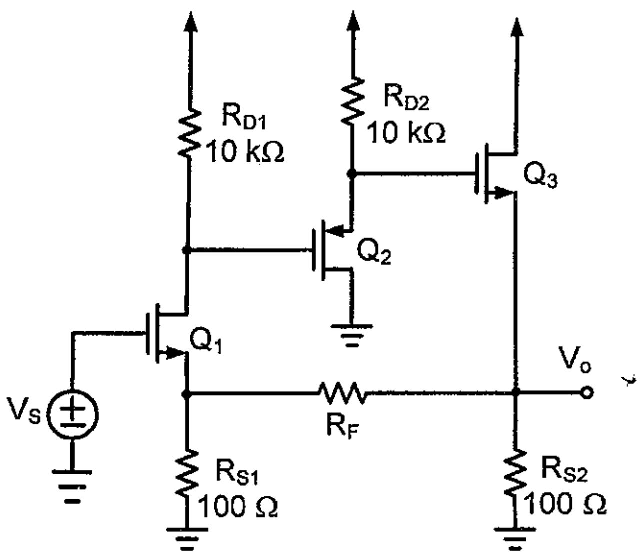

Fig. 4

5. An internally compensated op amplifier has a dc open-loop gain of 10^6 V/V and an ac open-loop gain of 40 dB at 10 kHz. Please estimate its 3-dB frequency (3%) and its gain-bandwidth product (3%).

6. An op amplifier having 106 dB gain at dc and a single-pole frequency response with unity-gain frequency f_t= 2MHz is used to design a non-inverting amplifier with nominal dc gain of 100. Please find the 3-dB frequency of the resulting amplifier. (5%)

7. For the circuit shown in Fig. 5, assuming that the op amplifier saturates at $\pm$12V and the diodes have a constant 0.7V drop when conducting.
   (a) Sketch and label the v_O-v_I transfer characteristic. (6%)
   (b) What is the maximum diode current? (3%)

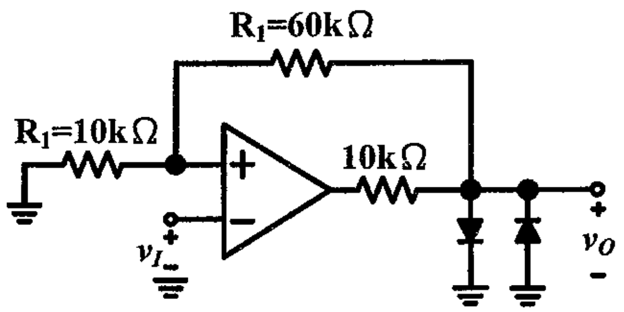

Fig. 5

8. For the output stage circuit shown in Fig. 6, V_{CC}=15V, V_{CEsat}=0.2V, V_{BE}=0.7V (constant), and β is very high.
   (a) Find the value of R that will establish a bias current sufficiently large to allow the largest possible output signal swing for R_L= 1 kΩ. (4%)
   (b) Determine the resulting output signal range (2%) and the minimum/maximum current for Q_1 (2%).
   (c) If the output voltage is an 8V-peak sinusoid, find (1) the power delivered to the load (2%); (2) the average power drawn from the supplies (2%); (3) the power-conversion efficiency (ignore the loss in Q_3 and R). (2%).

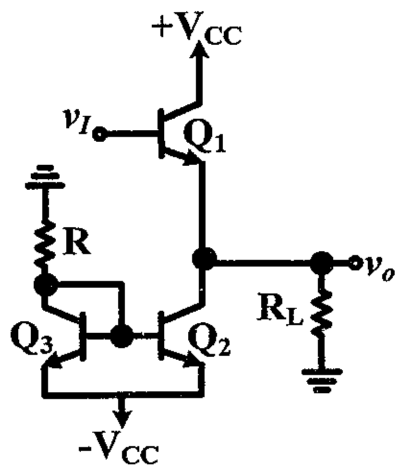

Fig. 6

9. For a second-order bandpass filter with center frequency of 10^5 rad/sec, a center-frequency gain of 10, and a 3-dB bandwidth of 10^3 rad/sec. Please derive and write down its s-domain transfer function. (6%)

10. Consider the circuit of Fig. 7. Break the loop at node X and find the resulting loop gain.
   (a) Find the possible frequency of oscillation. (5%)
   (b) Find the minimum value of R_f/R required for oscillation. (5%)

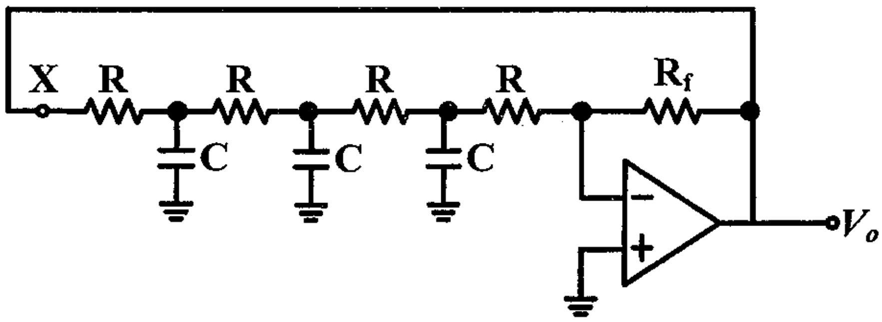

Fig. 7