1. Consider the circuit in Fig. 1.
   (1) For ideal op-amp, find the transfer function $T(s) \equiv V_O/V_I$. (10%)
   (2) If the op-amp has a finite voltage gain $A_0 = 100$, find the transfer function. (15%)

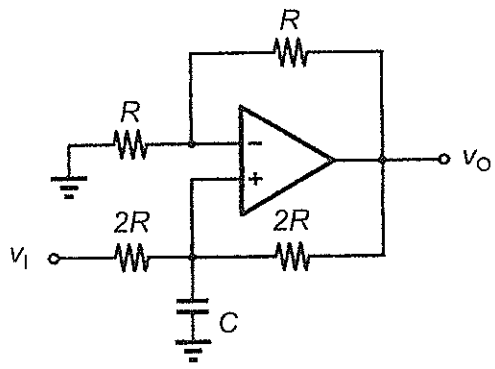

Fig. 1

2. Fig. 2 shows a differential amplifier, where the differential input voltage is defined as $v_{Id} = v_{G1} - v_{G2}$. The device parameters are given as $\mu_n C_{ox}(W/L)_n = 2$ mA/V^2, $\mu_p C_{ox}(W/L)_p = 1$ mA/V^2, $V_{tn} = |V_{tp}| = 0.5$ V, $V_{An} = |V_{Ap}| = 20$ V.
   (1) If a differential gain of 34 dB is required, find the value of current source I. (10%)
   (2) For a non-ideal current source, I is 200 μA and the equivalent output resistance is 100 kΩ. What is the CMRR in dB? (15%)

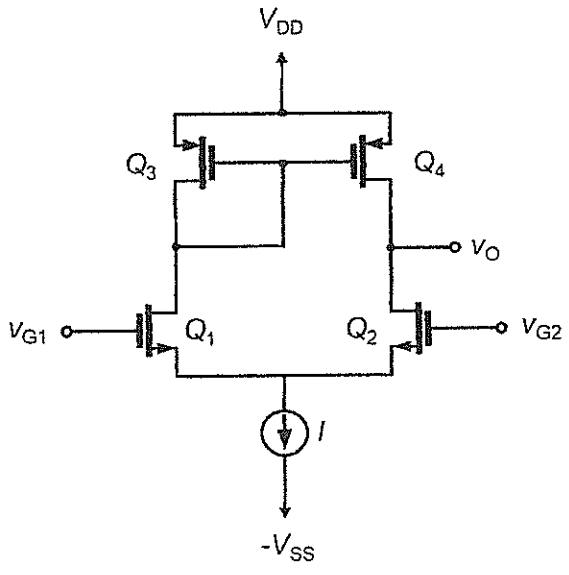

Fig. 2

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3. The circuit in Fig. 3 is a second-order active filter.
   (1) The parameters are given as R = 10 kΩ, R_1 = 10 kΩ, R_2 = 40 kΩ and C = 10 nF. Find the transfer function of the filter $T(s) \equiv V_O/V_I$. (10%)
   (2) The input is given by a 1.6-kHz sinewave with an amplitude of 0.1V. What is the amplitude of the output waveform? (10%)
   (3) If a dc gain of 2 is required, how do you choose the value of R_1? (10%)

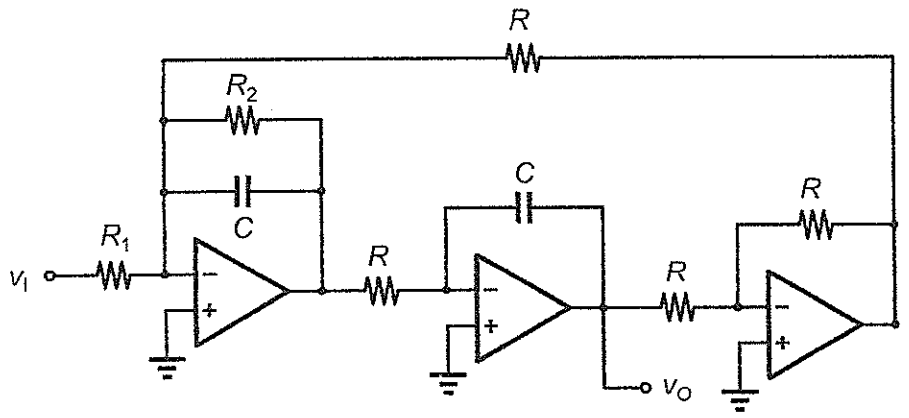

Fig. 3

4. For a complementary CMOS inverter as shown in Fig. 4, the parameters are given by $\mu_n C_{ox}(W/L)_n = 4\mu_p C_{ox}(W/L)_p$, $V_{tn} = |V_{tp}| = 0.5$ V, and $V_{DD} = 1.8$ V.
   (1) Find the input voltage at which $V_I = V_O$. (10%)
   (2) Find the ratio of t_{PHL}/t_{PLH}. (5%)
   (3) If the output capacitance is 50 fF, find the static power dissipation of the inverter. (5%)

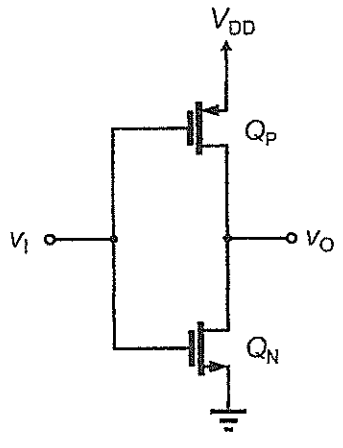

Fig. 4

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