1. Choose ALL correct statements from the following. [5%]
(a) For a common-base amplifier, the magnitude of the voltage gain is always less than unity.
(b) A common-base amplifier typically has a low input resistance.
(c) A common-collector amplifier typically has a high output resistance.
(d) The intrinsic gain of a common-emitter amplifier does not strongly depend on the bias current.
(e) The input resistance of a common-emitter amplifier does not change with the degeneration resistance.

2. Choose ALL correct statements from the following. [5%]
(a) The low-frequency response of an amplifier is due to parasitic capacitances of the transistors.
(b) The parasitic capacitance of an amplifier can be neglected at higher frequencies.
(c) The high-frequency response of an amplifier does not change significantly with the coupling capacitors.
(d) The influence of coupling and parasitic capacitances can be neglected at mid-band frequencies.
(e) Trade-off typically exists between amplifier gain and bandwidth.

3. Choose ALL correct statements from the following. [5%]
(a) Complementary CMOS logic has zero dynamic power dissipation.
(b) Complementary CMOS logic has zero static power dissipation.
(c) The delay of complementary CMOS logic can be significantly reduced by increasing the transistor size.
(d) The noise margin of a CMOS inverter can be adjusted by the aspect ratios of the transistors.
(e) The dynamic power of complementary CMOS logic is independent of the supply voltage.

4. Choose ALL correct statements from the following. [5%]
(a) For an op-amp circuit with a negative feedback, the output voltage is finite.
(b) Virtual-short property always applies for an op-amp circuit with a negative feedback.
(c) Negative feedback is widely used for bi-stable circuit applications.
(d) An op-amp inverting amplifier has very high input resistance.
(e) Positive feedback is used in an op-amp non-inverting amplifier.

5. The circuit in Fig. 5 is a second-order filter
  (a) Derive the transfer function of the filter. [10%]
  (b) If gain peaking is not wanted, how do you choose the value of Q? [10%]
  (c) Find the magnitude and phase of the filter gain at $\omega = 1/(RC)$. [10%]

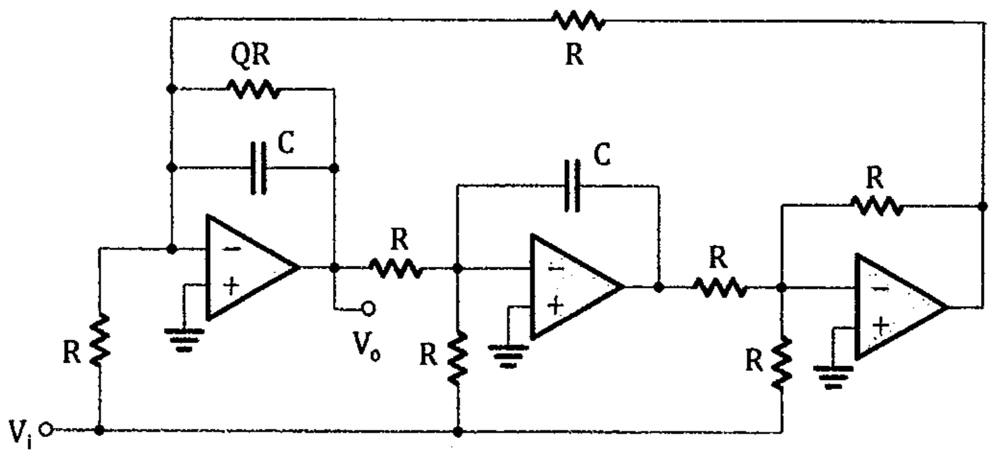

Fig. 5

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6. For the cascode amplifiers in Fig. 6, the MOSFET parameters are given as $\mu_n C_{ox} = 400\ \mu A/V^2$, $V_t = 0.5$ V, $V_A' = 5$ V/μm, W = 3.6 μm and L = 0.36 μm, while the BJT parameters are given as $\beta = 100$ and $V_A = 10$ V.

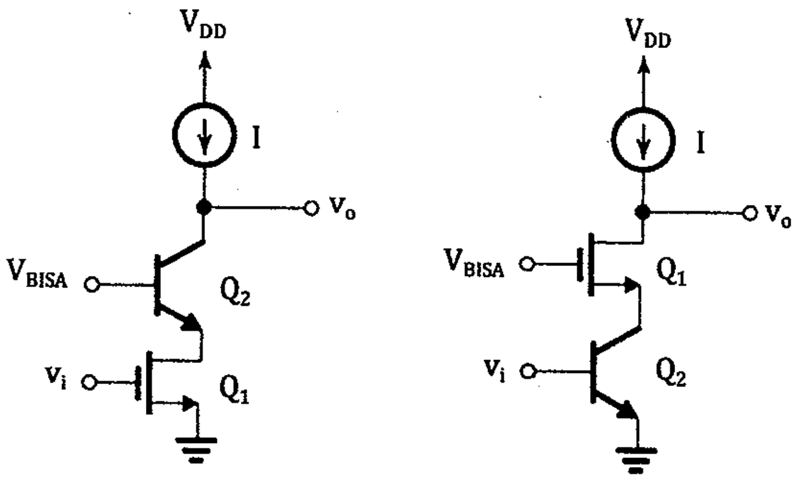
(a) Consider the circuit in Fig. 6(a). For I = 180 μA, find the minimum acceptable value of the dc voltage V_{BIAS}. What is the minimum value of the output swing? [10%]

(b) For I = 180 μA, $V_{BIAS} = 1.2$ V and $V_{DD} = 1.8$ V, find the voltage gain (v_o/v_i) and output resistance (R_{out}) of the amplifier in Fig. 6(a). [10%]

(c) For I = 80 μA, $V_{BIAS} = 1.2$ V and $V_{DD} = 1.8$ V, find the voltage gain (v_o/v_i) and output resistance (R_{out}) of the amplifier in Fig. 6(b). [10%]

(d) If a voltage gain of -7200 is required for the amplifier in Fig. 6(a), how do you choose the value of I? [10%]

(e) Assume that the voltage gain in Fig. 6(a) is A_{v1} and the voltage gain in Fig. 6(b) is A_{v2}. How does the ratio of A_{v1}/A_{v2} depend on the bias current I? [10%]



(a) (b)

Fig. 6