Nanyang Technological University
School of Electrical & Electronic Engineering
E2002 Analog Electronics – Tutorial 8

1. (a) What are the Q-points for the transistors in the amplifier in Figure 2 if $V_{CC} = V_{EE} = 12$ V, $\beta = 100$, $I_{EE} = 400\mu$A, $R_{EE} = 200$ kΩ, and $R_C = 39$kΩ, $V_A = \infty$?
(Ans: 198 μA, 4.98 V)

(b) What are the differential-mode and common-mode gains, common-mode rejection ratios (CMRRs) and output resistances for the cases of differential and single-ended outputs, respectively? What are the differential-mode and common-mode input resistances?
(Ans: differential output: –309, 0, ∞, 78.0 kΩ; single-ended output: –154.5, –0.0965, 64.1 dB, 38kΩ; 25.2 kΩ, 20.2 MΩ)

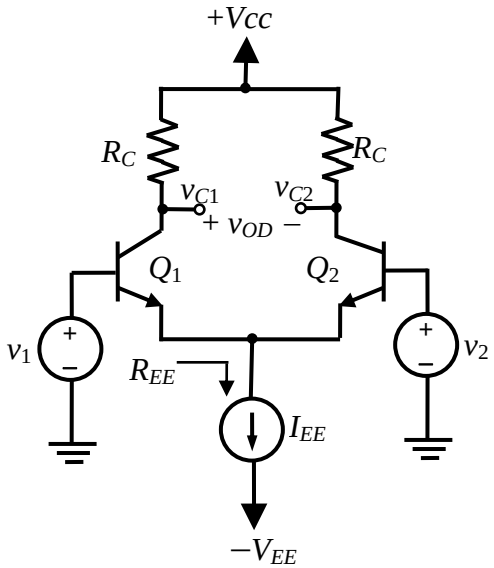

Figure 1

2. (a) What are the Q-points for the transistors in the amplifier in Figure 2 if $V_{DD} = V_{SS} = 15$ V, $I_{SS} = 300$ μA, $R_{SS} = 160$ kΩ and $R_D = 75$ kΩ? Assume that $K_n = 400\mu A/V^2$ and $V_{TN} = 1$V.
(Ans: 150 μA, 5.62 V)

(b) What are the differential-mode and common-mode gains, common-mode rejection ratios (CMRRs) and output resistances for the cases of single-ended and differential outputs, respectively? What are the differential-mode and common-mode input resistances?
(Ans: differential output: –26, 0, ∞, 150 kΩ; single-ended output: –13, –0.0232, 35 dB, 75 kΩ; ∞, ∞)

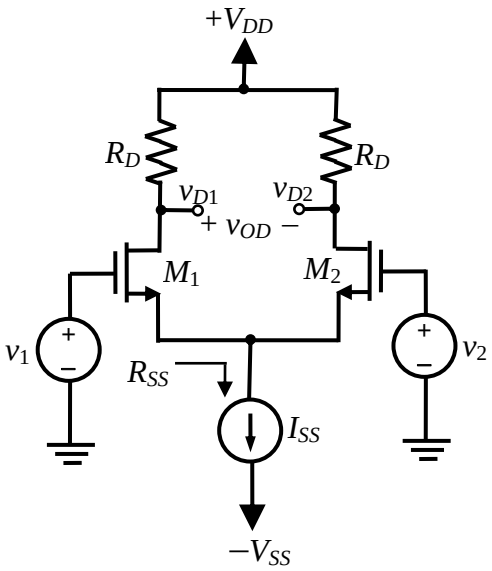

Figure 2

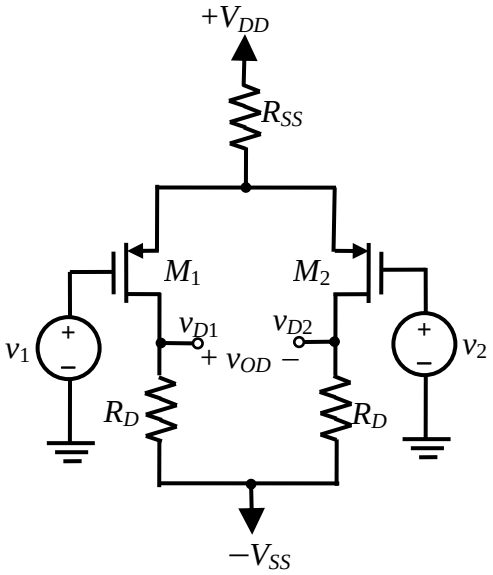

Figure 3

3. (a) What are the Q-points for the transistors in the amplifier in the Figure 3 if $V_{DD} = V_{SS} = 18$ V, $R_{SS} = 56$ kΩ and $R_D = 91$ kΩ? Assume that $K_p = 200\mu A/V^2$ and $V_{TP} = -1$V.
   Ans: (142 μA, 7.27 V)

   (b) What are the differential-mode and common-mode gains, common-mode rejection ratios (CMRRs) and output resistances for the cases of single-ended and differential outputs, respectively? What are the differential-mode and common-mode input resistances?
   Ans: (differential output: –21.57, 0, ∞, 182 kΩ; single-ended output: –10.78, –0.78, 22.81 dB, 91 kΩ; ∞, ∞)