Nanyang Technological University
School of Electrical & Electronic Engineering
E2002 Analog Electronics – Tutorial 6

1. The DC operating point of the common-emitter amplifier in Figure 1 has been calculated in Question 3 of Tutorial 5 to be I_C = 50 μA and V_{EC} =10.86 V. The pnp transistor Q_1 has β = 100 and V_A = 75V. Assume that the capacitors have infinite value, what are the voltage gain, input resistance, output resistance and current gain if $V_{CC} = V_{EE}$ = 15 V, R_I = 750 Ω, $R_1 = R_2$ = 200 kΩ, R_L = 100 kΩ, R_C = 100 kΩ, R_{E1} = 30 kΩ and R_{E2} = 250 kΩ.
(Ans: A_v = –1.62, R_{in} = 96.86 kΩ, R_{out} = 100 kΩ, A_i = –1.58; For fully bypassed R_E: A_v = –95.04, R_{in} = 33.33 kΩ, R_{out} = 100 kΩ).

   What is the amplitude of the largest ac signal that can appear at the output that satisfies the small-signal limit?
   (Ans: 505.12 mV)

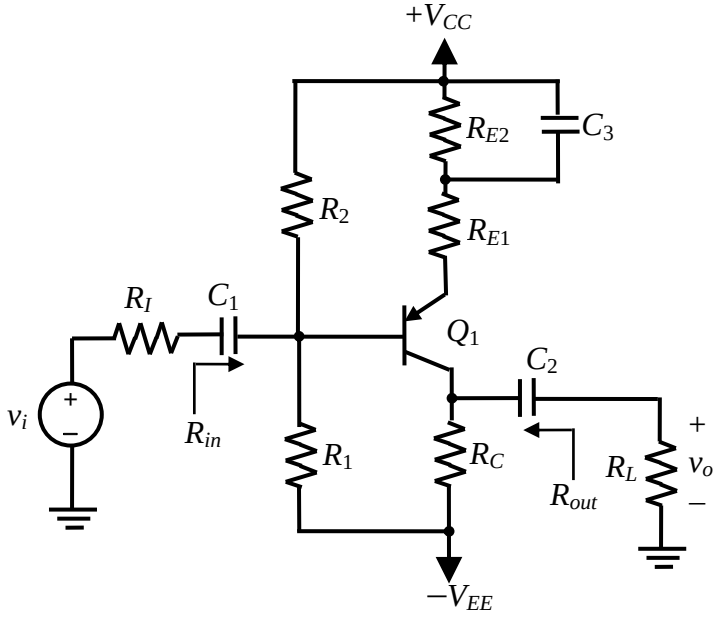

Figure 1

2. The DC operating point of the common-drain amplifier in Figure 2 has been calculated in Question 4 of Tutorial 5 to be I_D = 1.87 mA and V_{DS} = 9.39 V. The *n*-MOS transistor M_1 has K_n = 1 mA/V^2, V_{TN} = 1 V and λ = 0.02 V^{-1}. Assume that the capacitors have infinite value, R_I = 100 Ω, R_1 = 1.2 MΩ, R_2 = 910 kΩ, R_S = 3 kΩ, R_L = 250 Ω and V_{DD} = 15 V, calculate the voltage gain, input resistance and output resistance of the amplifier.
   (Ans: A_v = 0.31, R_{in} = 517.54 kΩ, R_{out} = 434.6 Ω)

   What is the maximum input signal amplitude for small signal operation?
   (Ans: 556.52 mV)

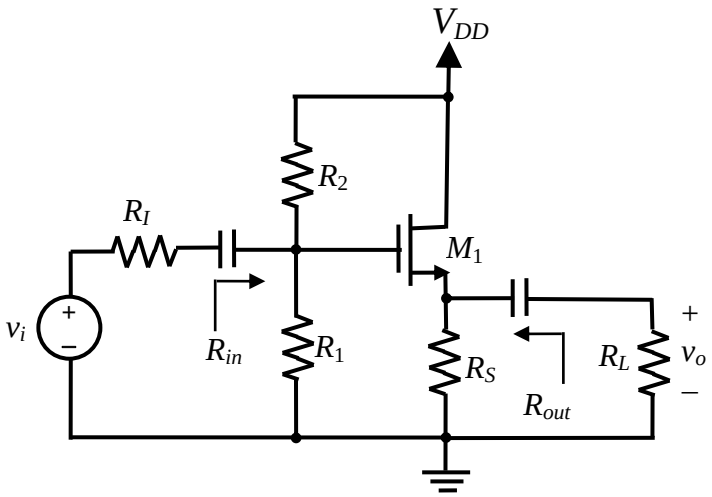

Figure 2

3. What are the voltage gain, input resistance and output resistance for the amplifier in Figure 3 if R_I = 250Ω, R_S = 68 kΩ, R_L = 200 kΩ, R_D = 43 kΩ and V_{DD} = V_{SS} = 15 V? What is the maximum input signal for the amplifier that satisfies the small-signal limit? Use K_p = 200 μA/V^2 and V_{TP} = −1V for your calculation.
(Ans: A_v = 8.98, R_{in} = 3.47 kΩ, R_{out} = 43 kΩ, $v_i \leq 0.292$ V)

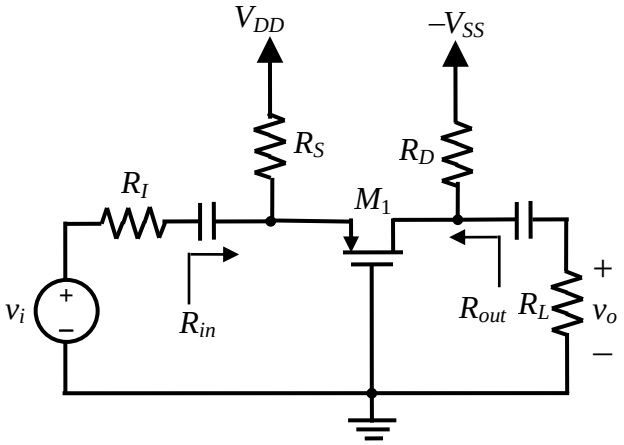

Figure 3