EE210: HW-12

Date: 04/04/2019

Q.1 For the differential pair shown in Fig. 1, determine the net voltage including dc and small-signal components at output nodes 1 and 2. $V_{s1} = 0.01sin(\omega_1 t)$; $V_{s2} = 1sin(\omega_2 t)$.

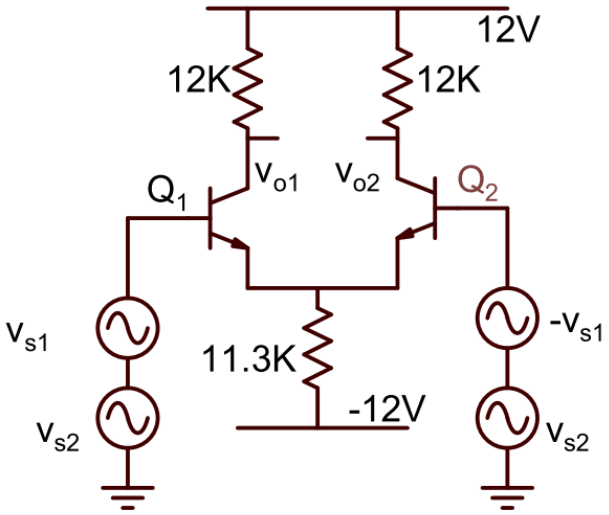

Fig. 1

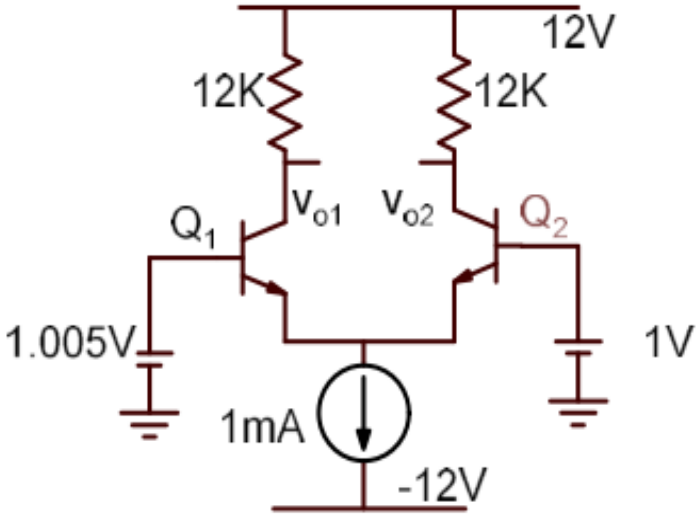

Fig.2

Q.2 For the amplifier shown in Fig. 2, determine dc value of collector currents of transistors Q1 and Q2. Assume that current source is ideal.

Q.3 In the differential pair shown in Fig. 3, there is a mismatch between transistors Q1 and Q2: $I_{s1} = 1.5I_{s2}$. Determine collector currents of transistors Q1 and Q2.

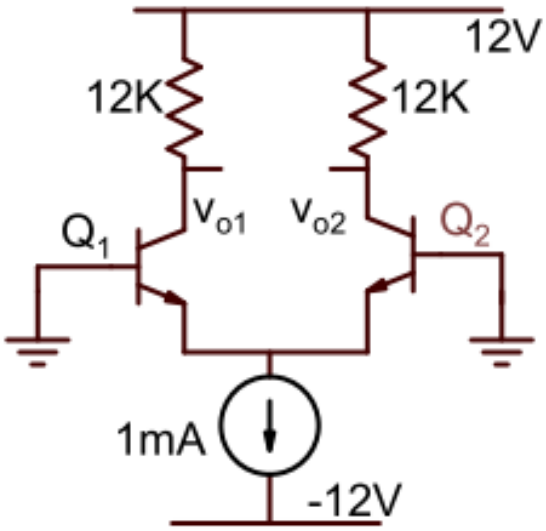

Fig. 3

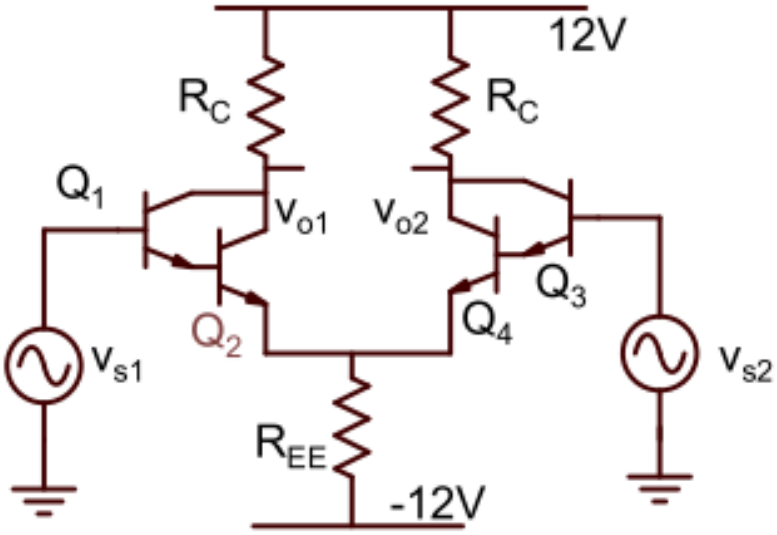

Fig.4

Q.4 Determine expressions for differential mode gain and input resistance for the amplifier shown in Fig. 4.

Q.5 For the differential amplifier shown in Fig. 5, a step input of 1V is applied to transistor Q1. Sketch the qualitative variation of output voltage. Determine the time taken for output voltage to reach 10V. Assume that transistors respond instantaneously to changes in voltage.

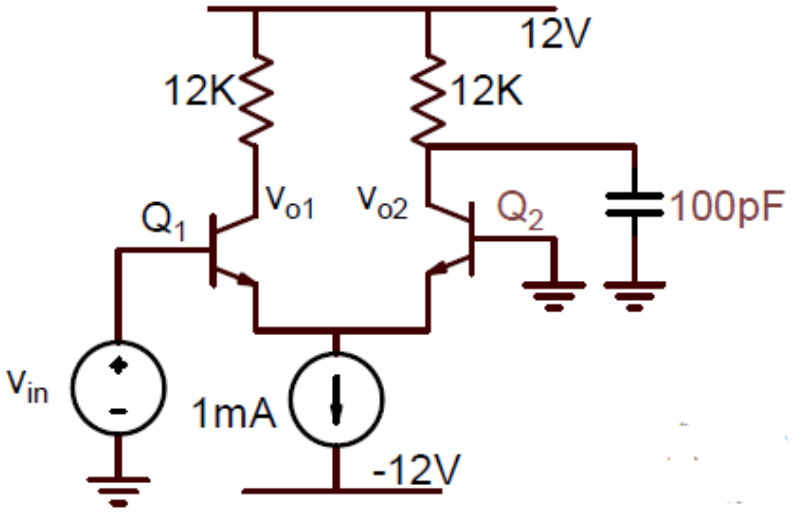

Fig. 5

Q.6 (a) In the differential amplifier shown in Fig. 6a, determine the values of resistors R_C and R_{EE} such that differential input resistance is 52kΩ and differential mode gain is 100.

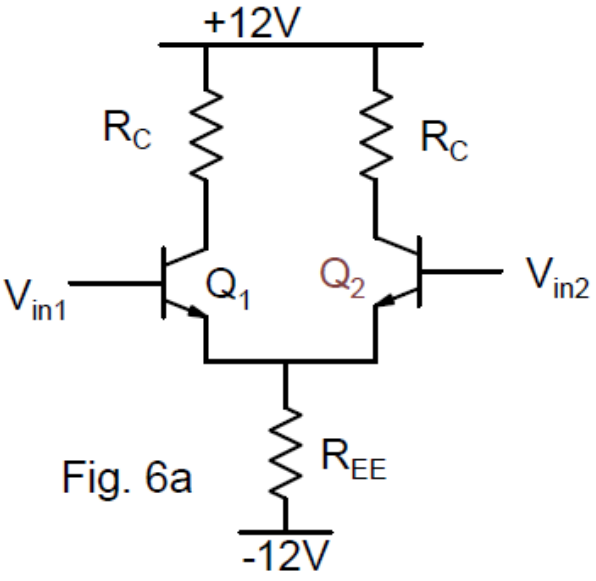

Fig. 6a

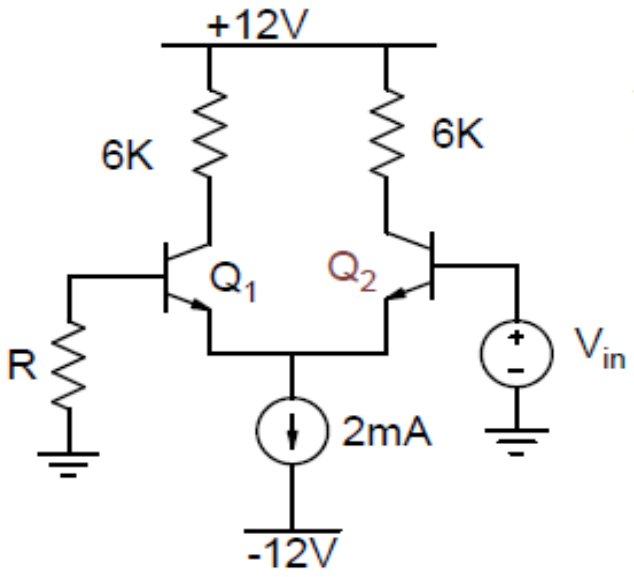

Fig. 6(a) Fig. 6(b)

(b) In the differential amplifier shown in Fig. 6(b), for zero input voltage the dc value of collector voltages of the two transistors were measured to be 5.5V and 6.5V. Assign these values to appropriate transistors and justify your answer. Determine the approximate value of small input voltage (dc) that needs to be applied to make both collector voltages equal to 6V. Current source is ideal.

Q.7 (a) Determine the common mode gain of the differential amplifier shown in Fig. 7(a).

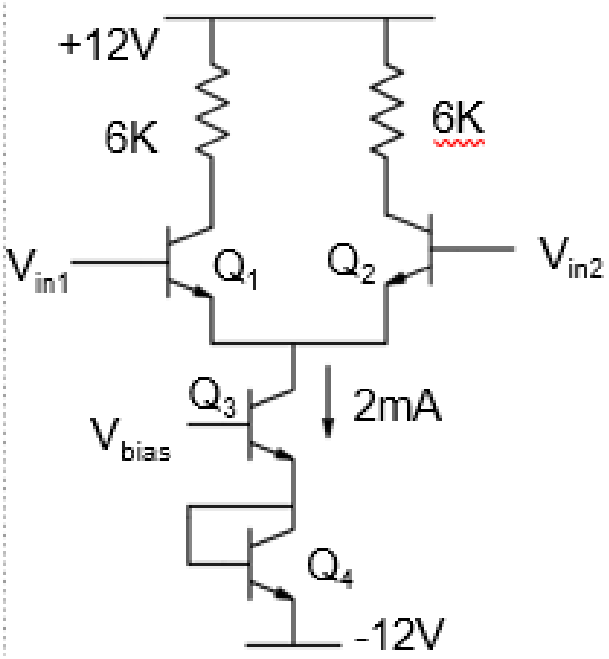

Fig. 7(a)

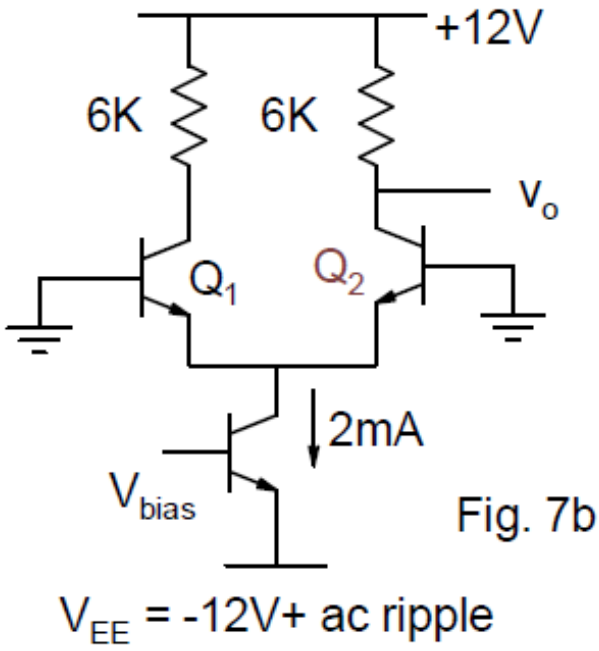

Fig. 7(b)

(b) In Fig. 7(b), the negative supply voltage V_{EE} has an ac ripple of 1mV magnitude. Determine the resulting ac ripple at the output.

Q.8 Determine the differential and common mode gain of the circuit shown below.

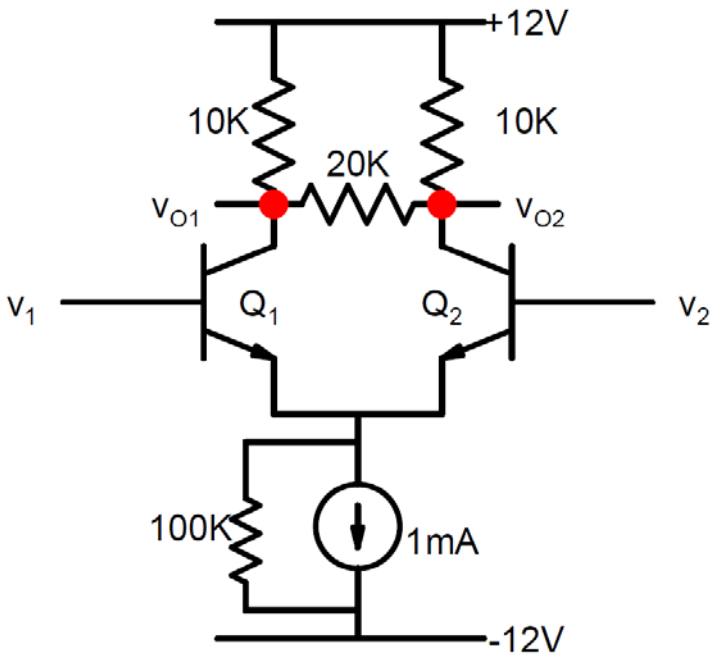

Fig. 8

Q.9 For the differential pair with current mirror load shown in Fig. 9, determine value of differential mode gain.

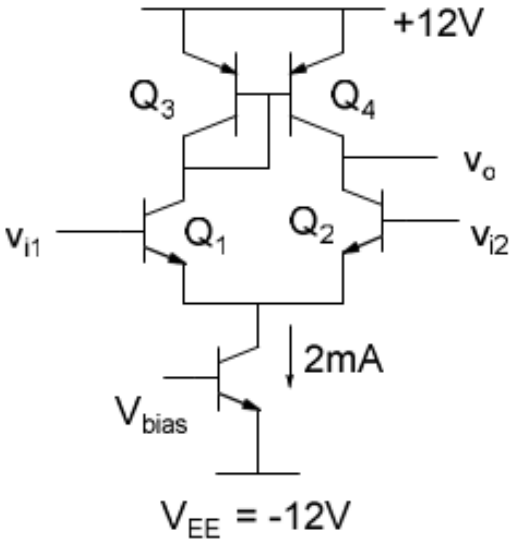

Fig. 9

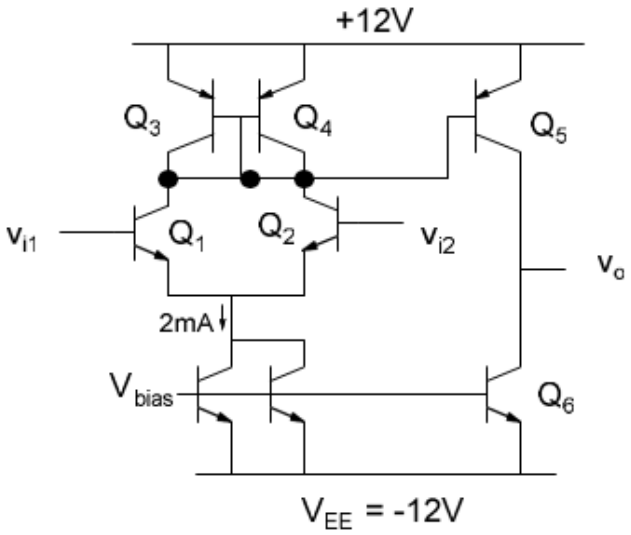

Fig. 10

Q.10 For the two-stage amplifier shown in Fig. 10, determine net differential voltage gain.

Q.11 Determine the small signal voltage gain of the amplifier shown in Fig. 11. Assume that current sources are ideal.

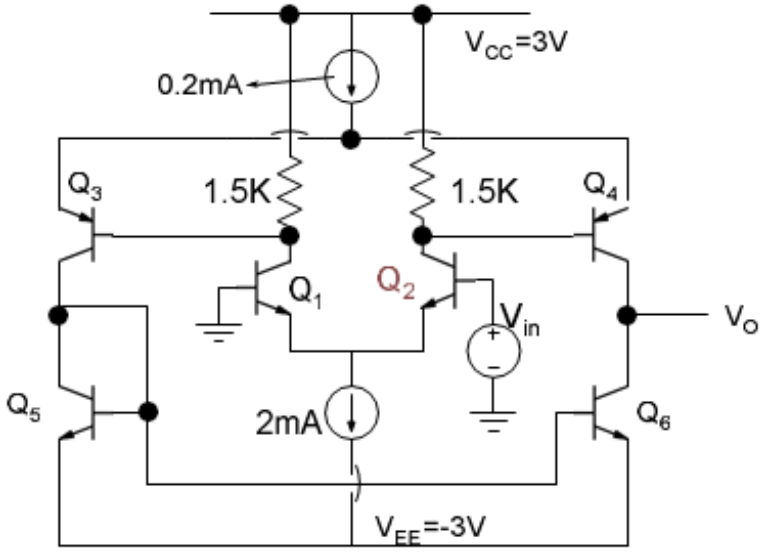

Fig. 11

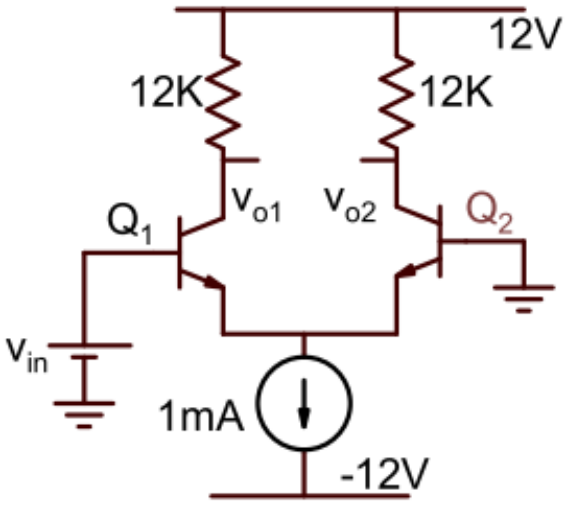

Fig. 12

Q.12 Determine the extra voltage V_{in} that needs to be applied to transistor Q1 shown in Fig. 12, in order to make collector currents of both the transistors identical, if $I_{s2} = 1.5I_{s1}$.