EE210: HW-5

Date: 05.02.2019

Unless stated otherwise, the BJT in the problems given below has the following characteristics

$$I_S = 2.03 * 10^{-15}A;\ \beta_F = 100;\ \beta_R = 1;\ V_A = 100;\ r_{bb} = 200\Omega;\ V_T = 26mV;\ C_{je0} = 1pF;$$
$$C_{jc0} = 0.5pF;\ C_{js0} = 3pF; m = 0.5;\ V_{bi} = 0.85;\ \tau_F = 1ns$$

Q.1 Design the amplifier shown in Fig.1 such that open circuit voltage gain is 100. What happens to the bias point if V_{BB} increases by 10%?

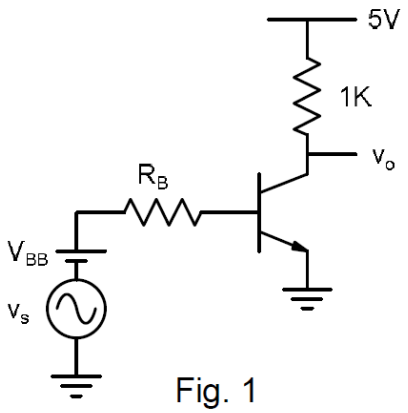

Fig. 1

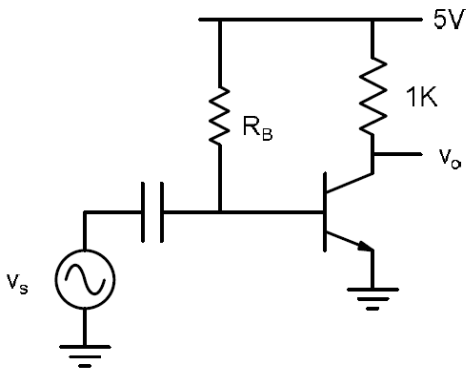

Fig. 2

Q.2 Design the amplifier shown in Fig. 2 such that open circuit voltage gain is also 100. What happens to the bias point if V_{CC} increases by 10%? What would be the impact on the amplifier's characteristics if β were to become 200?

Q.3 Two alternative bias schemes are shown below. Design these amplifiers also for an open circuit voltage gain of 100 and check their sensitivity to β. Also try to evaluate your design using circuit simulation.

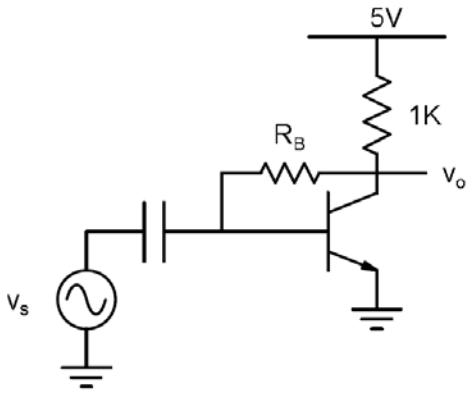

Fig. 3

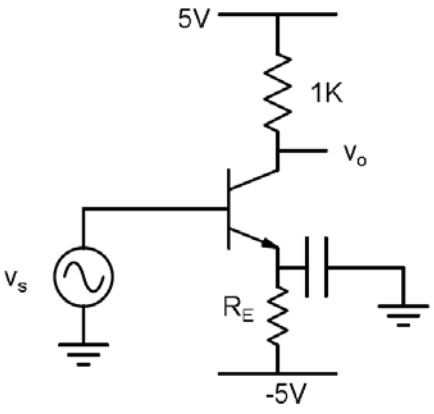

Fig. 4

Q.4 (a) Design the amplifier shown below in Fig. 5 such that: A_{V0} = -100; R_{in} = 1$k\Omega$.

(b) Determine the voltage gain and maximum voltage swing with 10% HD_2 distortion for R_L = 2kΩ. Assume a saturation voltage of ~0.2V.

(c) Determine the value of an extra un-bypassed emitter resistance that may be required to reduce open circuit voltage gain by half. Determine the new value of R_{in}. Simulate the circuit to determine the swing for harmonic distortion of 10%.

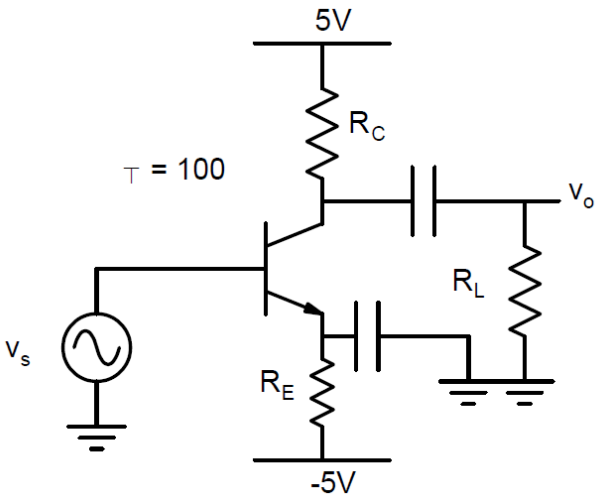

Fig. 5

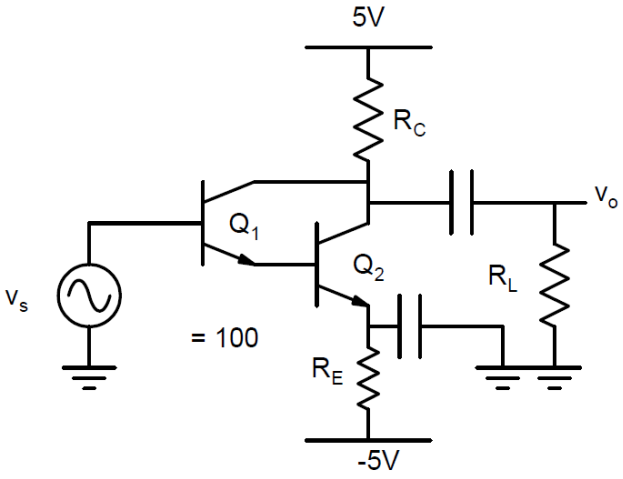

Fig.6

Q.5 Suppose the amplifier shown in Fig. 6 is designed with same bias point (I_{CQ} and V_{CEQ}) calculated earlier in Q.4. What would be the open circuit voltage gain and input resistance for this amplifier? Will the output swing be similar?