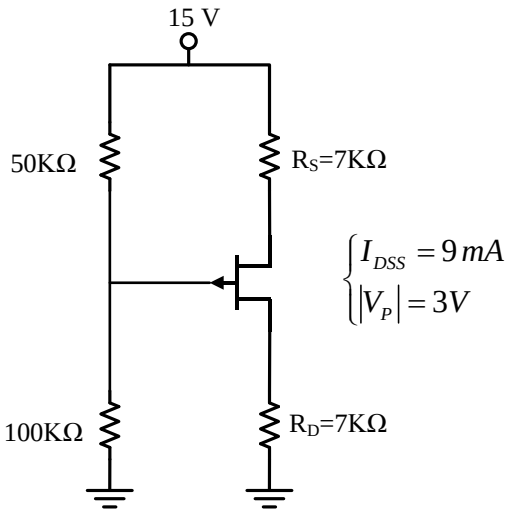
In the Name of Allah, the Most Beneficent, the Most Merciful.

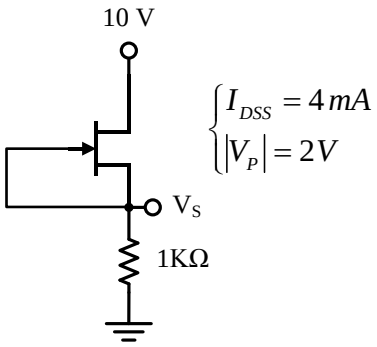
Electronics 1, Assignment #8, Miller effect, Output Swing, Bias point of JFETs.

Shahrood University of Technology

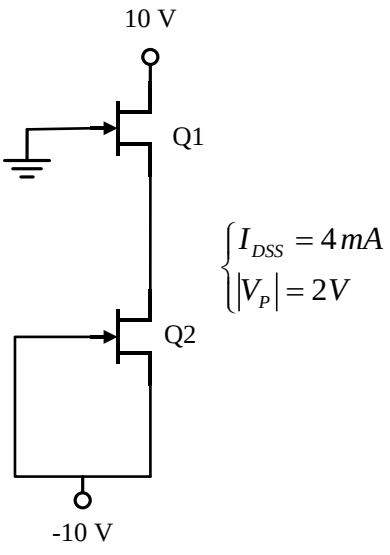
1. In the following circuits, determine the bias points of the transistors as well as their corresponding operation regions.



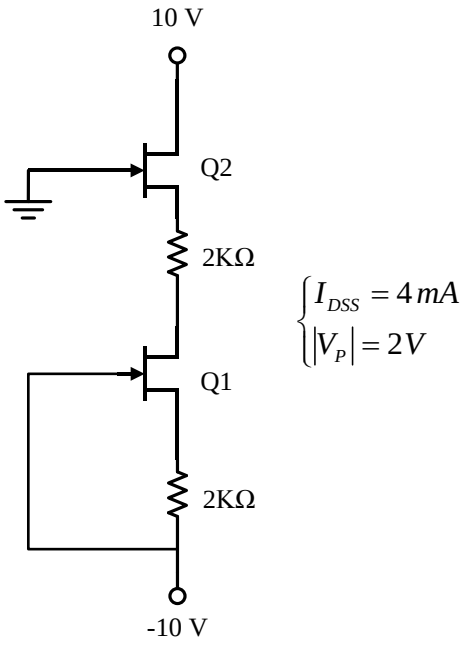
(a)



(b)

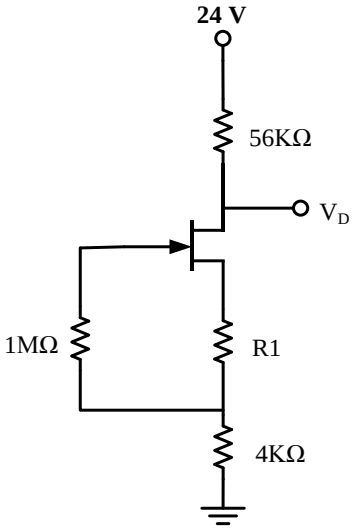


(c)

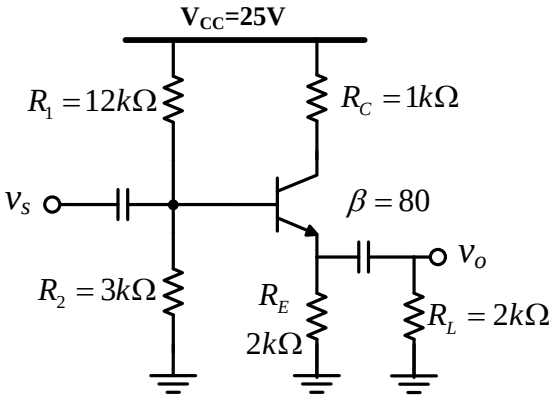


(d)

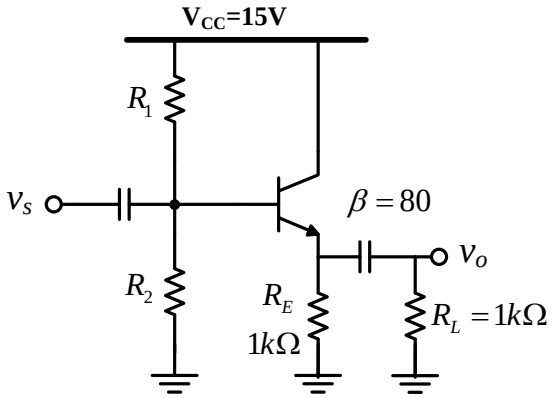
2. In the circuit of the following figure, the JFET transistor specifications are as follows: I_{DSS}=1mA and $|V_P|$=1 V. Determine R_1 such that V_D=10 V.



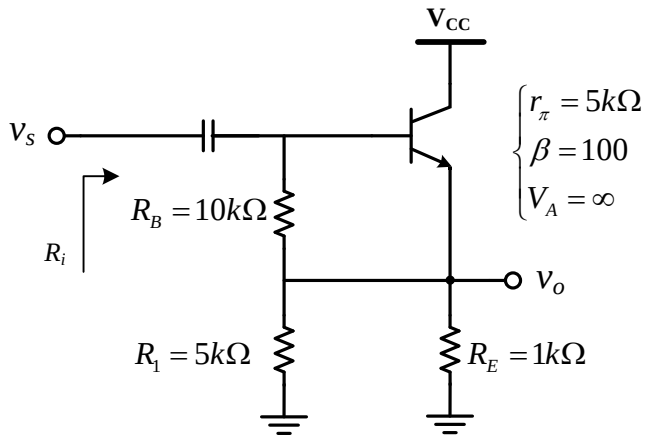
3. Determine the output voltage swing of the circuit shown below.



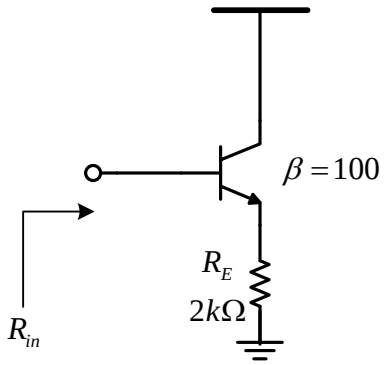
4. In the following circuit, estimate R_1 and R_2 such that the output voltage swing will be maximized. In addition, R_1 and R_2 should satisfy the following relation: $R_1 \| R_2 = 0.1 \times \beta \times R_E$ (This condition provides bias point stability)



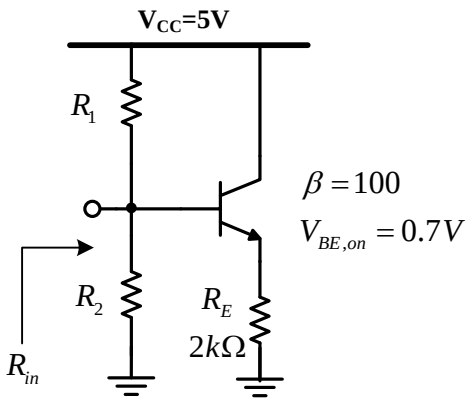
5. Using Miller effect, obtain the input resistance, R_i, for the following circuit.



6. One of the drawbacks of the bias circuit of BJT transistors, is that it limits the input resistance of the amplifier. To get more insight about this issue, consider a common-collector amplifier without the bias network, as shown in the circuit below, and determine the input resistance of the circuit (Seen from Base). Suppose the collector current is 1 mA.



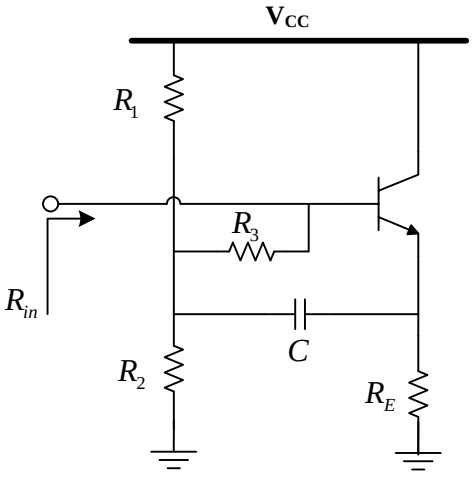
Now, design the bias network according to the following circuit. Calculate R_1 and R_2 so that the Base current can be ignored (bias point stability condition)



Afterwards, estimate the input resistance once again. It is seen that the input resistance decreases considerably. So the bias network, limits the input resistance. As a result, we cannot achieve high input resistance with the above structure.

In order to solve this issue, a technique called “bootstrap” is used. The structure of the bootstrap circuit is shown in the following figure. Here, in addition to the bias network, one more resistor as well as one capacitor are used.

Estimate the input resistance of this circuit and compare the results with those of the above circuit. Prove that in the bootstrap circuit, the input resistance is not limited to the bias network. (Hint1: Use miller effect. Hint2: A capacitor is modeled as a short-circuit element in small-signal analysis)



Good luck – M.R. Ashraf