

# ESC201A Assignment 7

Instructor Abhishek Gupta

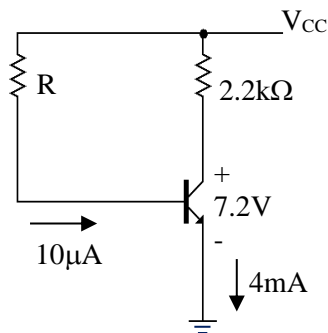
2023-2024 Semester I

## Topics

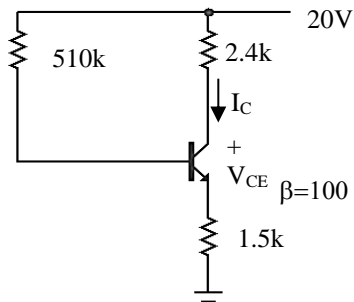
BJTs, OPAMPs

## Questions

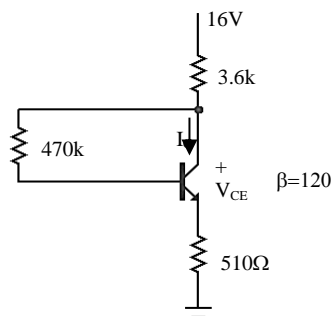
1. Determine  $V_{CC}$  and  $R_B$  in the following circuit.



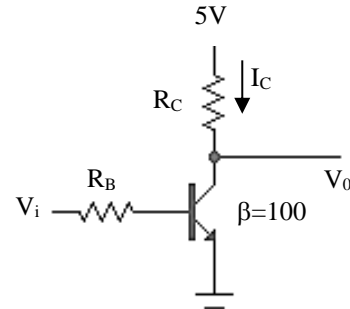
2. Determine  $I_C$  and  $V_{CE}$  in the following circuit.



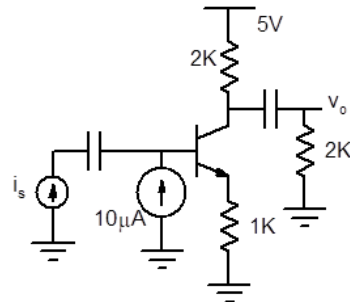
3. Determine  $I_C$  and  $V_{CE}$  in the following circuit.



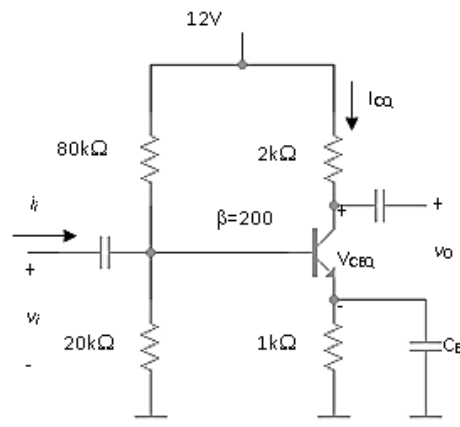
4. Determine  $R_B$  and  $R_C$  such that the transistor is in saturation with  $I_C=2\text{mA}$  and  $\beta_{\text{forced}}=20$  when  $V_i=5\text{V}$ . Draw the voltage transfer characteristics (a plot of  $V_o$  vs  $V_i$ ) with these resistances.



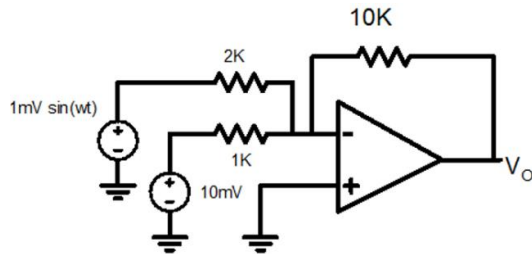
5. For the circuit shown below, carry out ac analysis to determine the ratio  $\frac{v_o}{i_s}$ , where  $v_o$  is ac output voltage and  $i_s$  is ac sinusoidal current. Assume that transistor is biased in forward active mode and current gain  $\beta=100$ .



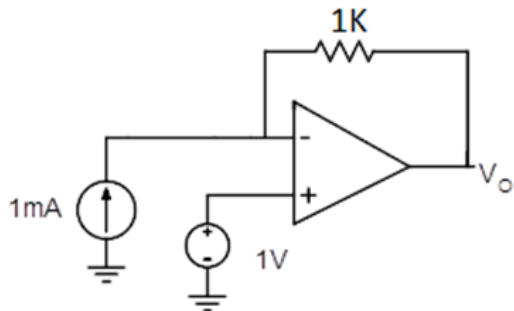
6. For the following circuit, calculate  $V_{CEQ}$  and  $I_{CQ}$ . Also, calculate the small signal voltage gain  $A_v = \frac{v_o}{v_i}$  and the input impedance ( $Z_i = \frac{v_i}{i_i}$ ).



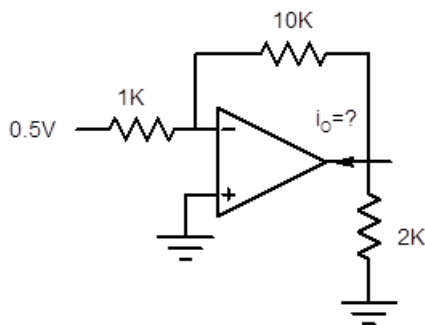
7. Determine the output of the ideal op-amp circuits shown below.



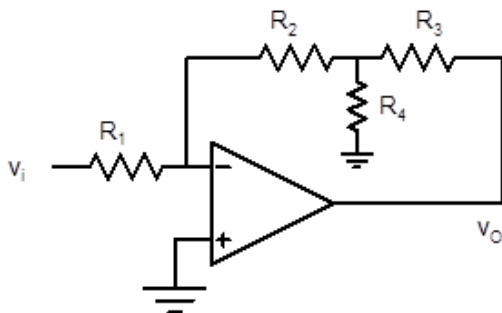
i.



ii.



iii.

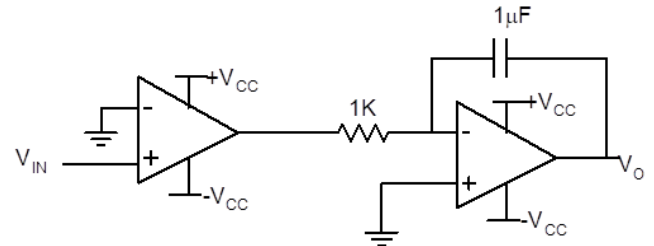


iv.

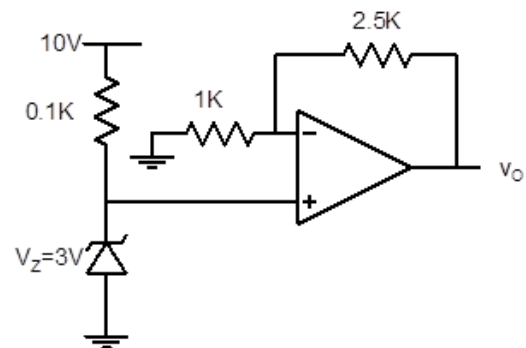
8. Design an op-amp circuit that would generate the following output voltage  $V_O = 2v_{s1} + 4v_{s2} - 8v_{s3} - 10v_{s4}$  where  $v_{s1}$ ,  $v_{s2}$ ,  $v_{s3}$  and  $v_{s4}$  are input voltages.

9. Design an op-amp circuit that can produce  $V_O = K \times V_{IN}^2$  where  $V_{in}$  is the input voltage.

10. Sketch the output voltage of the circuit shown below for  $V_{in} = 1V \sin(2\pi ft)$ ;  $f = 1KHz$  and supply voltages of  $\pm 5V$



11. Determine the output for the ideal op-amp circuit shown below.



12. Determine the output for the ideal op-amp circuit shown below. For the transistor assume a current gain of 100. What is the usefulness of each of the circuits?

