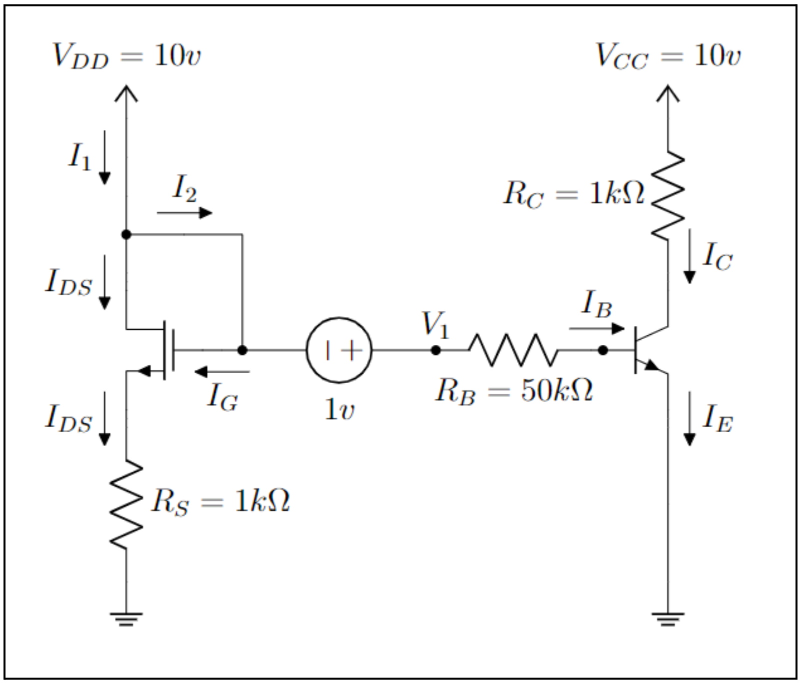
Assignment 4
CSE251
Total Marks: 40

1.



In the circuit above, the MOSFET and BJT have the following parameters,

$K = 4\ mA/V^2$, $V_T = 0.9$ v, $\beta = 100$, $V_{BE(active)} = 0.7$ v, $V_{BE(sat)} = 0.8$ v

(a) **Find out the gate voltage of the MOSFET.**
(b) Calculate V_1.
(c) Find out the expression for V_{GS},V_{DS} and V_{OV}.
(d) **Find** the operating mode of the MOSFET using the expressions from ©. [Hint: You don't need any assumption]
(e) **Calculate** I_{DS} and V_{DS} using the given parameters.
(f) Assume that the BJT is in the saturation mode. Now, **calculate** I_B, I_C, I_E. You must **validate** the given assumption.

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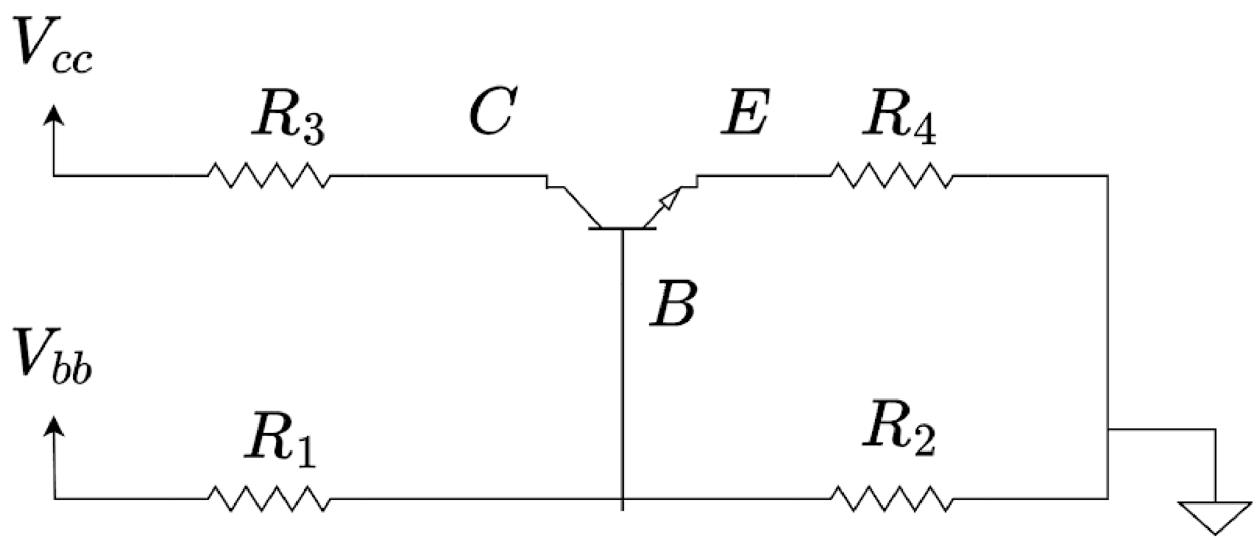
2.



In the above circuit, V_{bb} = 5V, V_{cc} = 15V, R_1 = 20kΩ(40kΩ), R_2 = 80kΩ(60kΩ), R_3 = 2kΩ and R_4 = 1kΩ. Also, assume current gain, Ic/Ib = 100.

a) Draw the equivalent circuit of BJT during saturation and active modes. [2]

b) Solve the above circuit and calculate I_B, I_C, I_E, V_{CE} and V_C using the method of assumed states. [Hint: try to find the Thevenin equivalent of the left hand side circuit from the B terminal and ground] [3]

c) If V_{bb} is changed from 5V to 5.1V, what happens to the outputs of the circuits? Calculate I_B, I_C, I_E, V_{CE} and V_C again. Now for a 0.1V increase in input V_{bb}, what is the change of I_c? Use $\Delta I_C = I_{C,new} - I_{C,old}$. [3+1]

d) Explain any use case of the differences in voltage increase between input and output. What could the use case be to such a phenomenon? [1]

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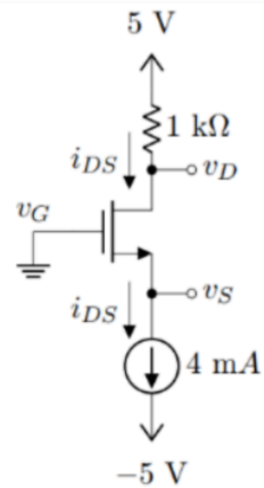
3.



Circuit 1

Refer to the **Circuit** above. For the MOSFET, $V_T = 1$ V and $k = k'_n \frac{W}{L} = 4$ mA/V^2.

(a) **Identify** the value of the gate voltage v_G and the drain-source current i_{DS}.

(b) **Calculate** the value of the drain voltage v_D using the 1 kΩ resistor.

(c) **Analyze** the circuit to find v_S. Here, **use** the Method of Assumed State. You must **validate** your assumptions. [Hint: assume $v_S = x$]

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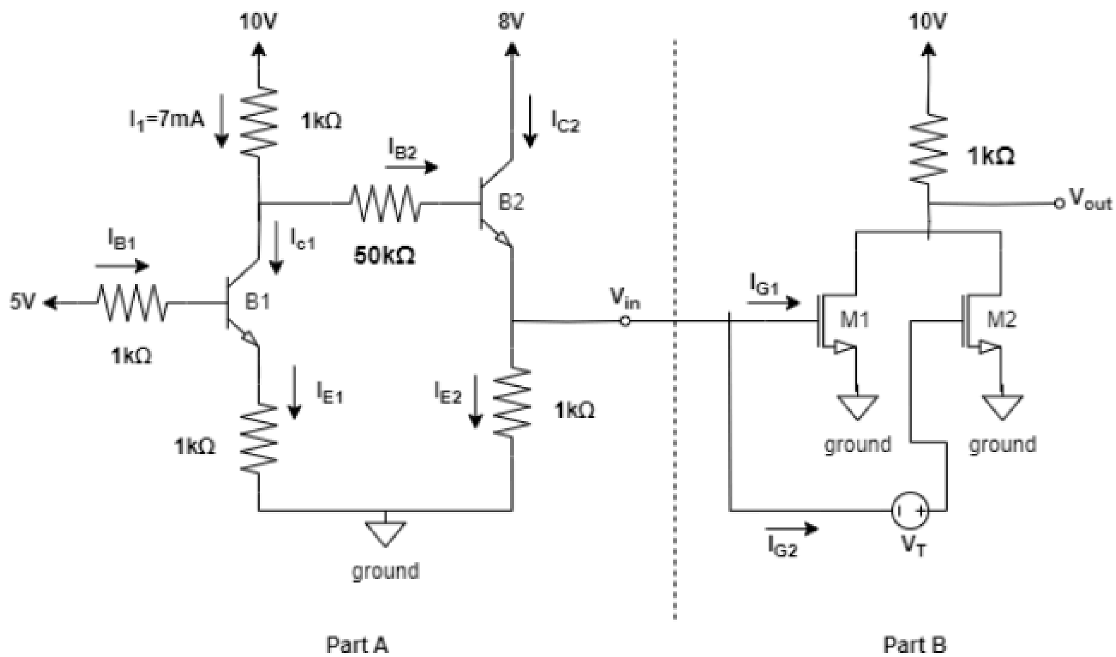
4.



In the circuit above, the BJTs have the following specification: β=100, Forward Active Region: $V_{BE} = 0.7\,V$, $I_C = \beta I_B$, Saturation Region: $V_{BE} = 0.8\,V$, $V_{CE} = 0.2\,V$,or the MOSFETs: $V_T = Threshold\,Voltage\,of\,M1\,and\,M2.$

(a) Determine i_{g1} and i_{g2}

(b) **Justify** why the SR model of MOSFET is more efficient than the S model ? [1]

(c) Assume, B1 and B2 are in the **Saturation region. Calculate i_{c2}.**

(d) Assume, B1 is in the **Forward Active region. Calculate Vin.**

(e) **Draw the VTC** of Part- B assuming, $V_T = 8\,V$. [Use S model of MOSFETs]