CSE350

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Sec: 07

Input A	Input B	Input (VA)	Input (VB)	V0	V1	V2	V3	V4	V5	V6
0	0	0	0	4.61312	0.71735	0.00769	0	5	4.80314	5
0	1	0	5	4.61312	0.75531	0.04940	0	5	4.80314	5
1	0	5	0	4.61312	0.75531	0.04940	0	5	4.80314	5
1	1	5	5	0.00940	2.66148	1.95156	1.04597	1.13839	0.57464	4.99692

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1. When the both the inputs are logical low (0.2 V) the values of Vbe1 & Vbe2 are 0.9 V which makes ~~if~~ the values of Vb1 & Vb2 0.9 V as well. However to turn on the transistors, T3 & T4 the value needs to be 1.4V. As a result, both T3 & T4 are in cutoff mode. On the other hand, there's current flow from Vcc to Vo through the transistor, T5 & the diode, D1. So, the output is logical high (3.3 V to 4.8 V).

We get logical high as output whenever there's at least one low input.

On the other hand, when both the inputs are logical high (5 V), the value is enough for the transistors, T3 & T4 to turn on which is greater than equal to 1.4V. However, the value of Vbe5 is not enough for T5 to

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turn on. So, T5 is in cutoff mode.

2. A totem is an object serving as the emblem of a family or clan and often as a reminder of its ancestry. The object is formed by stacking parts together. The output stage of this circuit is formed in such a way where the resistor comes first, then comes the transistor, after that comes the diode and finally comes another transistor. This setup seems just like a totem. That's how the name came.

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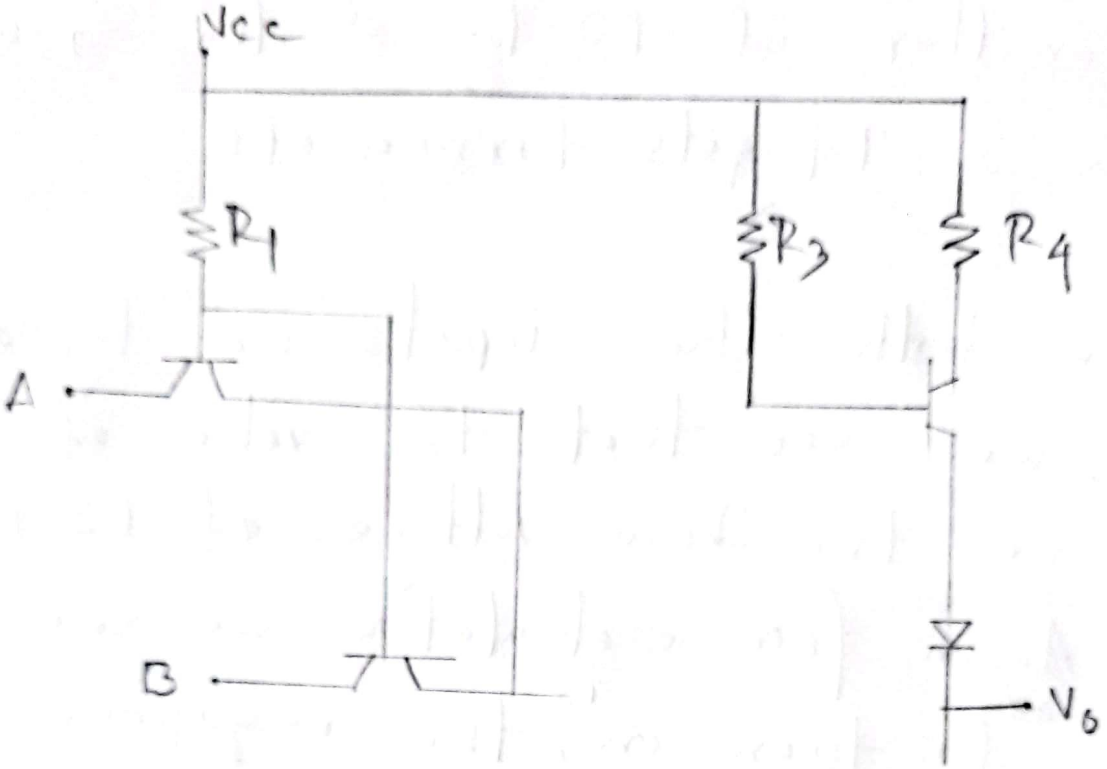
3.



4. The transistor, T3 is in phase splitter section of the TTL circuit. The job of T3 is to phase split. When the value of the base of T3 is logical low, it makes the value of the emitter of T3 logical high. As a result, when T5 is off, T4 gets turned on. On the other hand, when the value of the base of T3 is

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is logical high, it makes the value of the emitter of T3 logical low. So, when T5 is on, T1 gets turned off.

5. when both the inputs are logical high, we see that the value of Vb3 i.e. the base voltage of T3 is 0.9V. Again, from calculation we see that, to turn on T5, the required voltage is 1.4V (Vbe5 = 0.7V and D1 = 0.7V). If we don't use D1 then the required voltage for T5 to turn on becomes 0.7V, and as Vb3 = 0.9V, this turns T5 on however, if that happens then the circuit doesn't act like a NAND gate anymore.

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6. From problems data,

$V_c = V_6 = 5V$

$V_e = V_5 = 4.80314\,V$

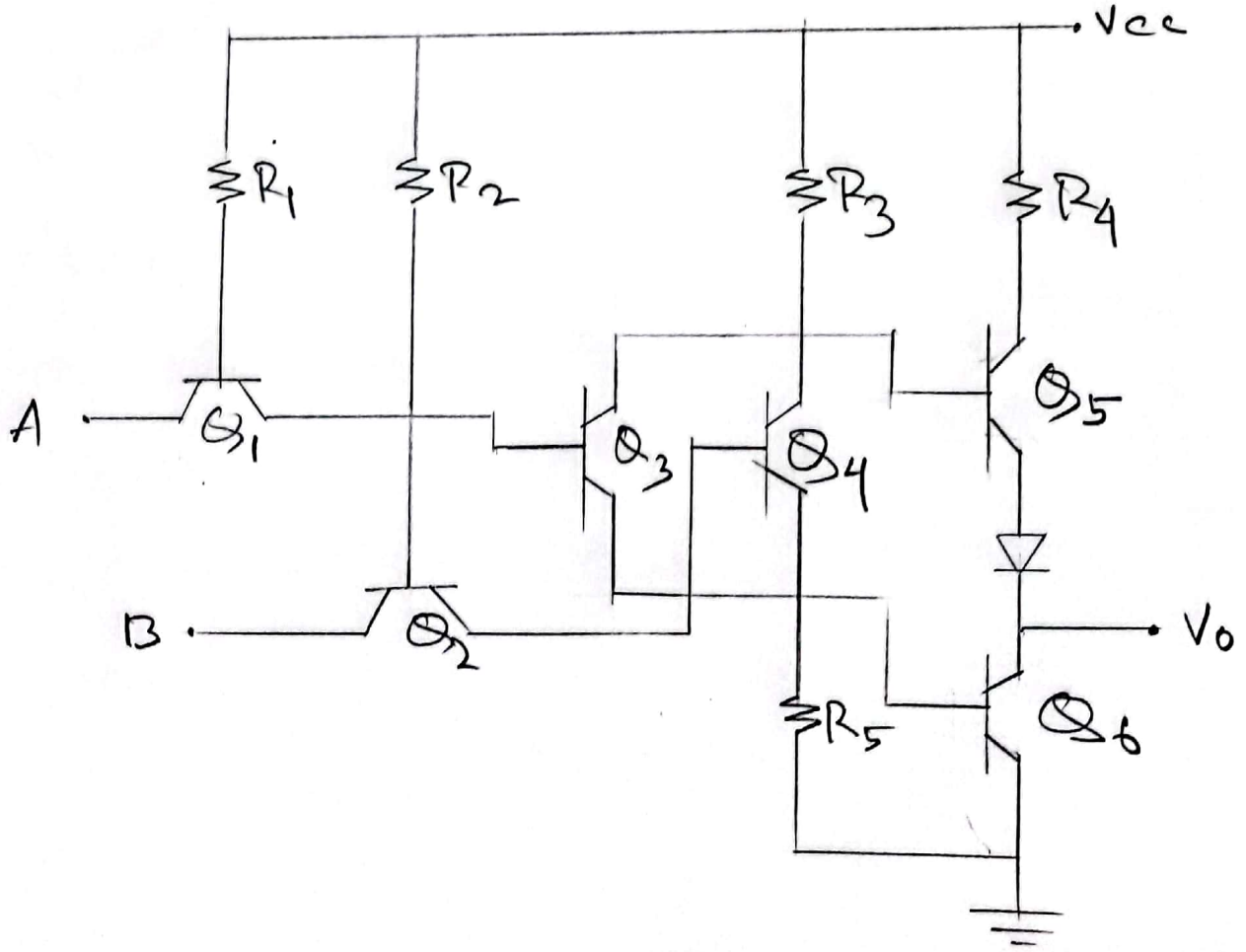
$V_c - V_e = V_{ee} = 0.19684\,V$

$\therefore V_{ee} \approx 0.2\,V$

$\therefore V_{ee} \geq 0.2$ for forward active mode

$\therefore$ T5 is in forward active mode.

7.



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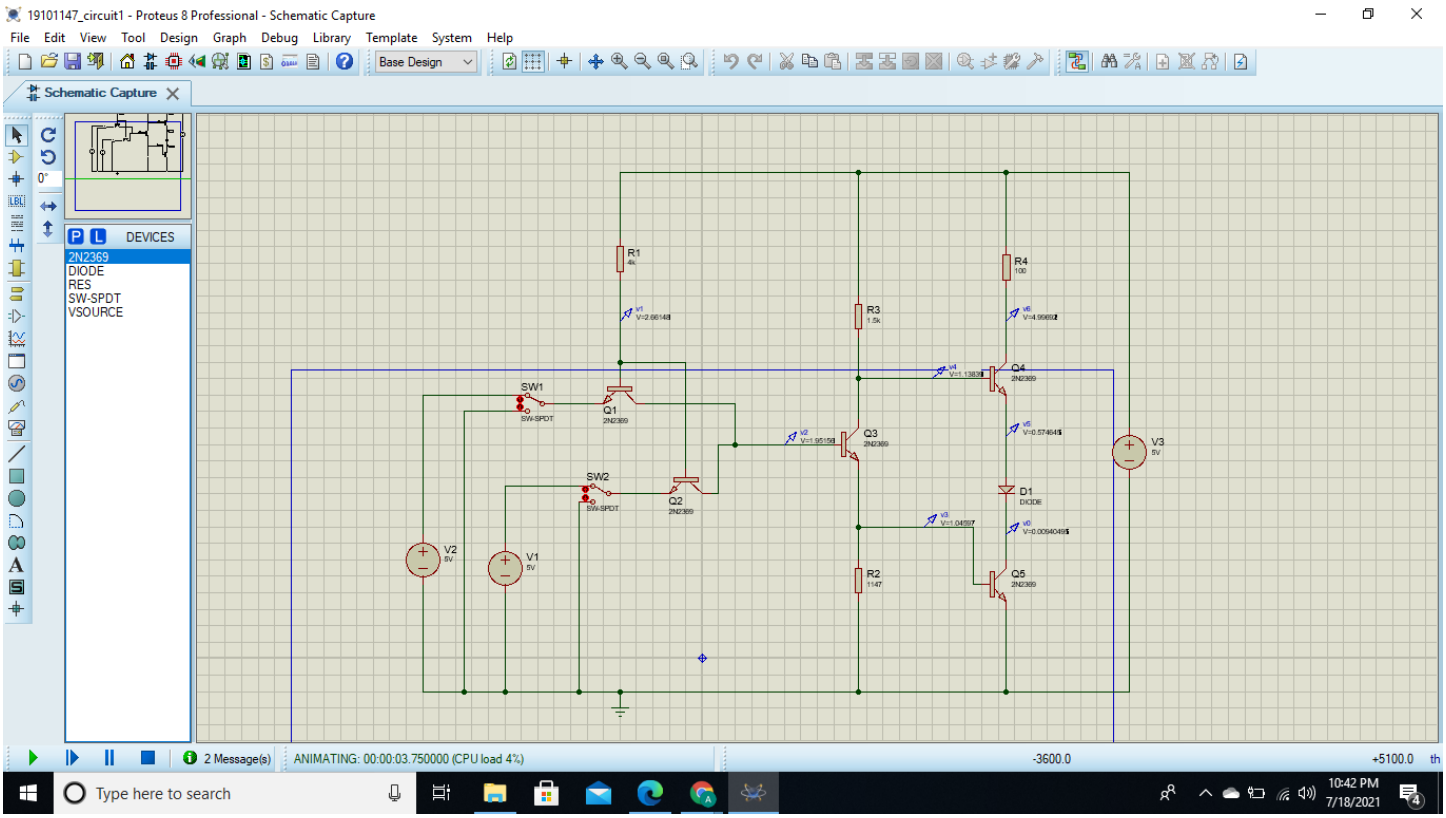
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