Semiconductors, pn Junction, ideal diodes - Fall 2020

1a) Silicon diodes have a 0.7 V drop across them (approximately). What is the cause of this 0.7 V drop?

1b) Why does the votlage drop across a silicon diode decrease as temperature goes up?
2) The resistance of a thermistor is given by

$$
R=1000 \cdot \exp \left(\frac{3905}{T}-\frac{3905}{278}\right) \Omega
$$

where T is the temerature in degrees Kelvin $(\mathrm{C}+273)$. Find the resistance and the temperature if the voltage at V 1 is 3.50 V for the following circuit.

| Resistance (R) | Temperature (T) |
| :--- | :--- |
|  |  |


3) Load Lines: Draw the load line for the following circuit and from the graph, determine Vd and Id

| Load Line | $\mathrm{Vd}($ Votls $)$ | $\operatorname{Id}(\mathrm{mA})$ |
| :---: | :---: | :---: |
|  |  |  |


4) The VI characteristics for a diode are

$$
\begin{aligned}
& V_{d}=0.052 \ln \left(10^{8} \cdot I_{d}-1\right) \text { Volts } \\
& I_{d}=10^{-8}\left(\exp \left(\frac{V_{d}}{0.052}\right)-1\right) \mathrm{Amps}
\end{aligned}
$$

Write the voltage node equations for the following diode circuit. (you don't have to solve - just give the equations)
Note: You should end up with six equations:

- Three for the diodes: $\{\mathrm{Id} 1, \mathrm{Id} 2, \mathrm{Id} 3\}$ in terms of $\{\mathrm{V} 1, \mathrm{~V} 2, \mathrm{~V} 3\}$, and
- Three for the voltage nodes


5) Assumd ideal diodes. Determine the voltages and currents assuming ideal silicon diiodes $(\mathrm{Vf}=0.7 \mathrm{~V})$

| V1 | V2 | V3 | Id1 | Id2 | Id3 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |
|  |  |  |  |  |  |


6) Assume ideal siliicon dioes. Determine the voltage, V1, and the currents, I1..I4

| V1 | I1 | I2 | I3 | I4 |
| :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |
|  |  |  |  |  |



Bonus! Where is the error in the following proof that $1=2$ ?
Assume: $a=b=1$

$$
\begin{aligned}
& a b=b^{2} \\
& a^{2}-a b=a^{2}-b^{2} \\
& a(a-b)=(a+b)(a-b) \\
& a=a+b \\
& 1=2
\end{aligned}
$$

