## ECE 320-Quiz 2: Name

February 5, 2015 - Ideal Diodes

1) Assume Vin $=+2 \mathrm{~V}$. Determine the voltage at Y and the currents I1, I2, I3. Assume ideal silicon diodes $(\mathrm{Vf}=0.7 \mathrm{~V})$

| Y | I1 | I2 | I3 |
| :---: | :---: | :---: | :---: |
| 0.9 V | 0 | 0.2 mA | 0.9 mA |



This is less than 2.1 V , so I1 $=0$ (three diodes require 2.1 V to turn on)
Do a voltage node at Y

$$
\begin{aligned}
& \left(\frac{Y-2}{1 k}\right)+\left(\frac{Y-0.7}{1 k}\right)+\left(\frac{Y}{1 k}\right)=0 \\
& Y=0.9 V
\end{aligned}
$$

2) Assume Vin $=+10 \mathrm{~V}$. Determine the voltage at Y and the currents I1, I2, I3. Assume ideal silicon diodes ( $\mathrm{Vf}=0.7 \mathrm{~V}$ )

| Y | I 1 | I 2 | I 3 |
| :---: | :---: | :---: | :---: |
| 2.1 V | 4.4 mA | 1.4 mA | 2.1 mA |



I1 is whatever it takes for the current to balance

$$
\begin{aligned}
& I_{i n}=I_{1}+I_{2}+I_{3} \\
& \left(\frac{10-2.1}{1 k}\right)=I_{1}+\left(\frac{2.1-0.7}{1 k}\right)+\left(\frac{2.1 V}{1 k}\right) \\
& 7.9 m A=I_{1}+1.4 m A+2.1 m A
\end{aligned}
$$

$$
I_{1}=4.4 \mathrm{~mA}
$$

3) Determine $\mathrm{Rr}, \mathrm{Rg}, \mathrm{Rb}$ so that the current through the LEDs are $1 \mathrm{~mA}, 2 \mathrm{~mA}, 3 \mathrm{~mA}$ respectively.

| Rr | Rg | Rb |
| :---: | :---: | :---: |
| $\mathbf{8 1 0 0}$ Ohms | $\mathbf{3 5 0 0}$ Ohms | $\mathbf{2 2 3 3}$ Ohms |



The voltage drop across a diode is approximately constant when Id $>0$
Red:

$$
\begin{aligned}
& R_{r}=\left(\frac{10 V-1.9 V}{1 m A}\right)=8100 \Omega \\
& R_{g}=\left(\frac{10 V-3.0 V}{2 m A}\right)=3500 \Omega \\
& R_{b}=\left(\frac{10 V-3.3 V}{3 m A}\right)=2233 \Omega
\end{aligned}
$$

4) Determine R1 R2 and the zener voltages Vz1 Vz2 so that the following circuit approximates the funciton shown

| R1 | Vz1 | R2 | Vz2 |
| :---: | :---: | :---: | :---: |
| $\mathbf{1 k}$ | $\mathbf{2 . 3} \mathbf{V}$ | $\mathbf{0}$ Ohms | 5.0 V |



5) The voltage and current through a blue LED is as follows:


Determine a linear curve fit for this data $(\ln (\mathrm{Id})=\mathrm{aV}+\mathrm{b})$ and the exponential curve fit $(\mathrm{I}=\mathrm{c} \exp (\mathrm{dV}))$

| $\ln \left(\mathrm{I}_{\mathrm{d}}\right)=\mathrm{a} \mathrm{V}_{\mathrm{d}}+\mathrm{b}$ |  | $\mathrm{I}_{\mathrm{d}}=\mathrm{c} \exp \left(\mathrm{d} \mathrm{V}_{\mathrm{d}}\right)$ |  |
| :---: | :---: | :---: | :---: |
| a | b | c | d |
| $\mathbf{5 8}$ | $\mathbf{- 1 8 3}$ | $\mathbf{e}^{-183}$ | 58 |

Slope:

$$
a=\left(\frac{\delta y}{\delta x}\right)=\left(\frac{18}{3.27-2.96}\right)=58
$$

Offset:

$$
\begin{aligned}
& -12=58 \cdot 2.96+b \\
& b=-183
\end{aligned}
$$

So

$$
\ln \left(I_{d}\right) \approx 58 V_{d}-183
$$

and

$$
e^{\ln \left(I_{d}\right)}=e^{58 V_{d}-183}=e^{-183} e^{58 V_{d}}
$$

Bonus:
"The 85 Richest People In The World Have As Much Wealth As The 3.5 Billion Poorest"
Forbes
http://www.forbes.com/sites/laurashin/2014/01/23/the-85-richest-people-in-the-world-have-as-much-weal th-as-the-3-5-billion-poorest/

One argument for this being a problem is described in the documentary "Inequality for All"

- Our economy is based upon consumerism

Ask yourself, which one has the greater impact on the economy?

- One family with an income of $\$ 50$ million
- One thousand families, each with an income of $\$ 50,000$

One thousand families will buy one thousand houses, two thousand cars (or more), four thousand beds, make one thousand suppers each evening, etc. The groceries they buy, the taxes they pay, their kids in school keep the grocer, schools, etc. in business.

Concentrating wealth in only one family results in an economic breakdown.

This is one reason the top tax bracket use to be $91 \%$. High tax brackets force executives to choose between

- Investing in their company,
- Starting a new company,
- Paying their employees, or
- Investing in their community.

Dropping the top tax bracket allows a 5th option:

- Keep company profits for yourself.

If high-income people were job creators, that might be a good thing. If concentrating wealth in a few families makes them job-killers rather than job creators, that is a problem.

