ECE 320 - Homework #4

LEDs, Clipper Circuits, Max/Min Circuits. Due Monday February 6th, 2017

1) An RGB Led has the following characteristics:

- Red: Vf = 2.2V @ 20mA, 8000mcd @ 20mA
- Green: Vf = 3.2V @ 20mA, 8000mcd @ 20mA
- Blue: Vf = 3.2V @ 20mA, 8000mcd @ 20mA

Design a circuit to output orange light

- Red = 31% (of 20mA)
- Green = 100% (of 20mA)
- Blue = 50% (of 20mA)

Assume a +10V source. The current you need for each color is then

Red:

$$I_r = 0.31 \cdot 20mA = 6.2mA$$
$$R_r = \left(\frac{10V - 2.2V}{6.2mA}\right) = 1258\Omega$$

Green:

$$I_g = 1.00 \cdot 20mA = 20mA$$
$$R_g = \left(\frac{10V - 3.2V}{20mA}\right) = 340\Omega$$

Blue:

$$I_g = 0.50 \cdot 20mA = 10mA$$
$$R_b = \left(\frac{10V - 3.2V}{10mA}\right) = 680\Omega$$



2) A white 3W led has the following characteristics:

- Vf = 3.5V @ 700mA
- 270 Lumens @ 700mA

Design a circuit to drive this LED at 700mA. Assume you have a 10VDC power supply available.

I = 700 mA (given)

$$R = \left(\frac{10-3.5}{700mA}\right) = 9.3\Omega$$



Problem 3-10) Design a clipper or max/min circuit.

Clipper Circuit: $y = 2 \ln(x + 1)$ 3) Requirements: Specify what your circuit does Inputs: 0..10V, capable of up to 10mA Outputs: > 100k ohms Relationship: $y = 2 \ln(x + 1)$ Tolerances: $\pm 0.25V$

4) Analysis: Design a circuit to meet your requirements.

```
Draw straight lines to approximate y(x) within 0.25 volts.
```



Section 1: Slope = 1.33. Add a non-inverting amplifier with a gain of 1.33 Add a 1k resistor at the output (something much less than 100k load)

Section 2:

• Turn on at y = 2V. Zener is 2V

• Slope =
$$0.5$$

$$1.33 \cdot \left(\frac{R_2}{R_2 + 1k}\right) = 0.5$$
$$R_2 = 602\Omega$$

Section 3:

- Turn on at y = 4V. Use a 4V zener.
- Slope = 0.2
 - $1.33 \cdot \left(\frac{R}{R+1000}\right) = 0.2$
 - $R = R_2 ||R_3 = 177\Omega$
 - $R_3 = 250\Omega$



5) Test: Check your analysis with PartSim (or similar program)





Х	1	2	3	4	5	6	7	8	9	10
2ln(x+1)	1.38	2.19	2.77	3.21	3.58	3.89	4.16	4.39	4.6	4.79
PartSim	1.29	2.23	2.74	3.24	3.74	4.1	4.32	4.53	4.73	4.93
Error	0.09	-0.04	0.03	-0.03	-0.15	-0.21	-0.16	-0.14	-0.13	-0.14

All voltages are within tolerance (0.25V).

6) Validation: Build your circuit and collect data in lab to see if your analysis is correct and if you meet your requirements.

Х	1	2	3	4	5	6	7	8	9	10
2ln(x+1)	1.38	2.19	2.77	3.21	3.58	3.89	4.16	4.39	4.6	4.79
Measured										
Error										