## ECE 320 - Homework \#4

Max/Min Circuits, Clipper Circuits, Transistor Theory. Due Monday, September 21st

## Max/Min:

1) Determine the voltages and currents for the following max/min circuit. What function does this circuit implement? $Y=f(A, B, C, D)$
2) Check your results in CircuitLab (or similar program)


Problem 1-2.

## Clipper Circuits:

3) Design a circuit to approximate the following function subject to the following requirements:

- Input: 0 .. 10 V , capable of 100 mA
- Output: 100k resistor
- Relationship: Graph below, +/- 200mV

4) Check your design in CircuitLab

5) Design a circuit which meets the following requirements:

- Input: -10 .. +10 V , capable of 100 mA
- Output: 1 k resistor
- Relationship:

$$
V_{\text {out }}=\left\{\begin{array}{cc}
+6 \mathrm{~V} & V_{\text {in }}>+6 \mathrm{~V} \\
V_{\text {in }} & -6 \mathrm{~V}<V_{\text {in }}<+6 \mathrm{~V} \\
-6 \mathrm{~V} & V_{\text {in }}<-6 \mathrm{~V}
\end{array}\right.
$$

## Transistors

6) Determine the current gain, $\beta$, for the transistor show below. Also label the off, active, and saturated regions.
7) Draw the load-line and determine the Q-point for

- $\operatorname{Vin}=0 \mathrm{~V}$
- $\mathrm{Vin}=3 \mathrm{~V}$
- $\mathrm{Vin}=6 \mathrm{~V}$



## Lab (over)

## Lab: Please include a photo of your circuit to receive credit for problems 8-10

8-10) Build the following circuit with your electronics kit.

- Measure Vce and Ic for $1 \mathrm{k}<\mathrm{Rb}<$ infinity.
- Determine the operating point for each conidition and the current gain for your 3904 transistor
- Draw the load line on the graph below and mark each point you measured

| Rb | lb | Vce | Ic | Current Gain <br> (lc/lb) | Operating Region <br> (off / active $/$ <br> saturated) |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 k <br> $\mathrm{br}-\mathrm{bl}-\mathrm{re}$ |  |  |  |  |  |
| 10 k <br> $\mathrm{br}-\mathrm{bl}-\mathrm{or}$ |  |  |  |  |  |
| 100 k <br> $\mathrm{br}-\mathrm{bl}-\mathrm{ye}$ |  |  |  |  |  |
| 1 M <br> $\mathrm{br}-\mathrm{bl}-\mathrm{gr}$ |  |  |  |  |  |
| infinity |  |  |  |  |  |



