Problem 1

The Relay requires 30 mA to actuate. Specify the maximum value of $R_B$ that can be used if the Relay is to close when $V_{in} > 4$ Volts.

Problem 2

Show that the following circuit is a Zero crossing detector. To do this, run a transient analysis with pspice. Let $V_{in}$ be a Sine wave ($V_0 \sin \theta$). Plot $V_{in}$ and $V_o$ and show that $V_o$ does something when $V_{in}$ goes through Zero.
In PSpice use "4.7Meg" to specify 4.7MΩ and use "10Meg" for 10MΩ.

Problem 3

Design an analog/digital circuit that monitors an analog input and has a single digital output. The circuit has the following truth table.

<table>
<thead>
<tr>
<th>Vin</th>
<th>Vo</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4V ≤ Vin ≤ 3</td>
<td>1</td>
</tr>
<tr>
<td>Vin &gt; 3</td>
<td>0</td>
</tr>
<tr>
<td>Vin &lt; -4</td>
<td>0</td>
</tr>
</tbody>
</table>

Assume 3 all opamps use ±15V supplies and all logic circuits use 0 ±5V supplies. You will need clamps to interface between the opamps and logic gates.
Problem 4

Design an analog/digital circuit that does the following:

1) The output of the circuit is a Flip Flop.
2) At power-up, the output is automatically set to zero.
3) The circuit monitors sound. When the sound goes above an adjustable level, the clock input to the Flip-Flop is used to flip the output to a 1.
4) Once the flip flop output is set to a "1" it will remain there until the user presses a push-button to clear the output to a 0.
5) The output of the flip flop drives an LED. The LED should be on when the output of the flip flop is a 1.