**Problem 1: 3.4b (P92)** The following circuits are called clipping circuits. Assume ideal diodes and sketch the output voltage $V_o$ for two cycles of the input $V_i$.

Solution: the period of $V_i$ is: $T = \frac{2\pi}{\omega} = \frac{2\pi}{2\pi} = 1(s)$, the input voltage is shown as:

Since the diode is ideal, the voltage drop across the diode is zero volt.
For $V_i > +0.5V$, the diode is reversed biased $\Rightarrow$ the diode is OFF. No current will go through the circuit. $V_o = V_i - R \times 0 = V_i$.
For $V_i < +0.5V$, the diode is forward biased $\Rightarrow$ the diode is ON. The current will go through the circuit. $V_o = +0.5V$.

**Problem 2  3.13 (P95)** In the following circuit, find the minimum $V_{in}$ required and the resulting voltage $V_{out}$ to put the transistor in full saturation. Assume that the beta for the transistor is 100 in full saturation.

Solution: When the min $V_{in}$ that makes the transistor in full saturation, the following equations are true: $V_{CE} = 0.2 \, V$, $V_{BE} = 0.7 \, V$, and

$$I_C = 100 \, I_B$$

$I_B$ can be found from the input circuit:

$$I_B = \frac{V_{in} - V_B}{R_B} = \frac{V_{in} - (0.7 + V_{out})}{1000} \Rightarrow V_{in} = 1000I_B + 0.7 + V_{out}$$

$I_C$ can be found from the input circuit:

$$I_C = \frac{V_C - V_{out}}{R_C} = \frac{5 - (0.2 + V_{out})}{1000} \Rightarrow V_{out} = 4.8 - 1000I_C$$

In addition:

Dr. Winney Du, E310F, MAE Dept., SJSU, Tel.: 408-924-3866, E-mail: wdu@jusu.edu
Solve about 4 equations, we have: $V_{in} = 3.13 \text{ V}$ and $V_{out} = 2.41 \text{ V}$ (see the figures below).

**Problem 3 3.18 (P96)**

*Solution* The upper FET is a p-channel enhancement mode MOSFET and the lower is an n-channel enhancement mode MOSFET. When $V_{in} = 5\text{ V}$, the upper MOSFET doesn’t conduct (since it needs a negative voltage to turn on) but the bottom one does, so $V_{out} = 0\text{ V}$ (ground).