Well, first of all there are 0.15 V/°C produced by the measurement, so the output of the measurement is $0.15T$ V. Second, the differential amplifier will subtract 3 V (the setpoint) and then amplify the result by 10 (ten). Thus the input to the diodes and the relays is:

$$V_D = 10(0.15T - 3)$$

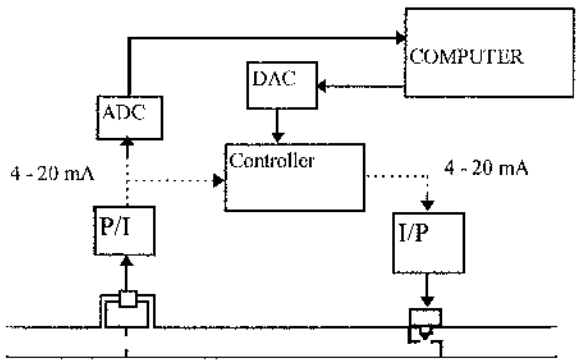
or, solving for T, since that is what we want to find,

$$T = (3 + V_D/10)/0.15$$

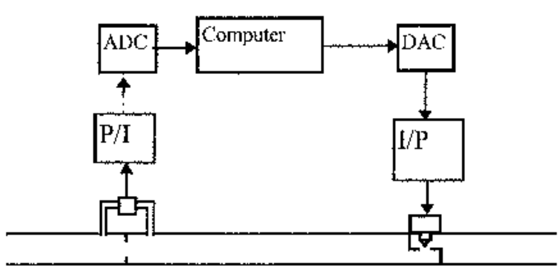
If we assume ideal diodes with no forward voltage drop, then the temperatures can be found from the above equation by setting V_D equal to +1.5 V, +1.1 V, -1.1 V, and -1.5 V and solving for T in each case.

+1.5 V: cooler on, $T = (3 + 1.5/10)/.15 = 21$ °C
+1.1 V: cooler off, $T = (3 + 1.1/10)/.15 = 20.7$ °C
-1.1 V: heater off, $T = (3 - 1.1/10)/.15 = 19.3$ °C
-1.5 V: heater on, $T = (3 - 1.5/10)/.15 = 19$ °C

1.12 For Supervisory Control:



For Computer Control:



1.13

First of all we need a manual valve on the cold water, a temperature sensor on the mixed hot and cold water and a temperature readout. Then on the hot water side we need a control system to regulate the hot water valve. The system block diagram for analog and digital control is shown in the following diagrams: (a) analog