Literature:

Semiconductor and PN junction: p 42-72

Diode: p 166, 167, 175 – 186

Assignments:

1.1:

In the laboratory, 2 sets of related values of current and voltage at two temperatures have been measured for the diode 1N4001:

- At 25℃ : (V_{D1}, I_{D1}) = (540 mV, 1mA), and (V_{D2}, I_{D2}) = (450 mV, 0.1mA)
- At 75℃: (V_{D1}, I_{D1}) = (420 mV, 1mA), and (V_{D2}, I_{D2}) = (315 mV, 0.1mA)
  a. Calculate the constants of the diode equation: n and I_s for each temperature.
  b. Calculate the temperature coefficient [mV/K] of the diode at current = 1 mA.

Hint: use the approximated equation: $I_D = I_s\, e^{\frac{V_D}{n V_T}}$ and $V_D = n\, V_T\ \ln \frac{I_D}{I_s}$

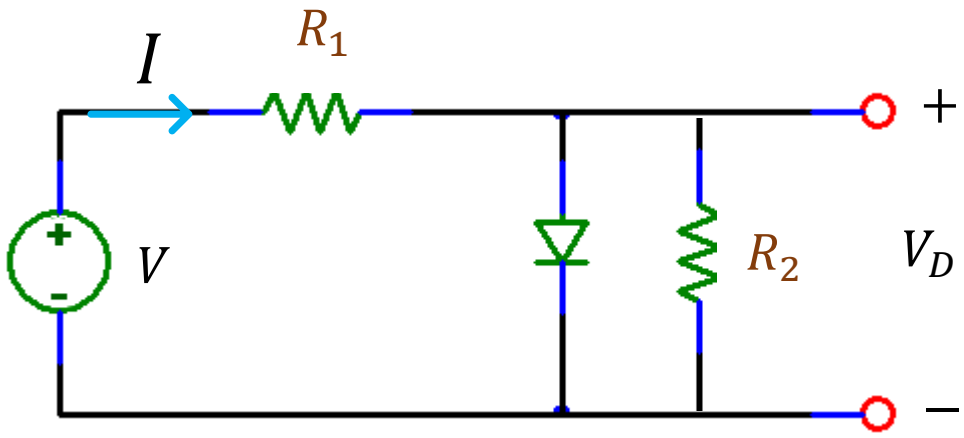
1.2:

Assuming a diode operates in reverse bias and forward bias regions, explain the process, and plot the following curves by using:

1. The ideal model.
   a. Draw the equivalent circuit and calculate $I, I_{R_1}, I_{R_2}, V_{R1}, V_D$ and V_{R2}
      - When $V < 0$
      - When $V = 0$
      - When $V > 0$
   b. The I-V curve.
   c. The I_{R_2}-V curve.
   d. The I_D-V curve.
   e. The V_{R1}-V curve, with V_{R1} denoting the voltage across R1.
   f. The V_D-V curve, with V_D denoting the voltage across diode.
2. the constant voltage drop model:
   g. Draw the equivalent circuit and calculate $I, I_{R_1}, I_{R_2}, V_{R1}, V_D$ and V_{R2}
      - When $V < V_{D,on}$

- When $V = V_{D,on}$
- When $V = \frac{R_1+R_2}{R_2} V_{D,on}$
- When $V > \frac{R_1+R_2}{R_2} V_{D,on}$

h. The I-V curve.
i. The I_{R_2}-V curve.
j. The I_D-V curve.
k. The V_{R1}-V curve, with V_{R1} denoting the voltage across R1.
l. The V_D-V curve, with V_D denoting the voltage across diode.
m. The V_{R2}-V curve, with V_{R2} denoting the voltage across R2.



1.3:

Simulate the circuit in the above figure using LTspice. Set $R_1 = 100\ \Omega$, $R_2 = 200\ \Omega$, diode 1N4148, and linearly sweep V from -10 to 20 V, with 0.1 V step. Plot the following curves:

a. The I-V curve.
b. The I_{R_2}-V curve.
c. The I_D-V curve.
d. The V_{R1}-V curve, with V_{R1} denoting the voltage across R1.
e. The V_D-V curve, with V_D denoting the voltage across diode.
f. The V_{R2}-V curve, with V_{R2} denoting the voltage across R2.