Lecture 5

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1 Small Signal Model

Let's say there is some fluctuation in voltage. In a circuit diagram, we can consider the voltage source to be a DC source and AC source (with amplitude ΔV) connected in series.

If we have a linear system, we can

- Use superposition to solve the circuit

- Use linear algebra

For the above equation, if $\Delta V(t)$ is small, we can "scale" current up and get

$$i_D(t) \approx I_D \left(1 + \frac{\Delta V(t)}{V_T}\right)$$

Where we take the Taylor approximation of the solution

$$i_D(t) = I_D \exp\left(\frac{\Delta V(t)}{V_T}\right)$$

Where I_D is the current with only the DC source.

1.1 Resistor Model

We can also use the resistor model, where we only turn one of the voltage sources on for superposition. If ΔV is small enough, then we can treaat the

diode as a resistor, where resistance is given by voltage and current solutions from the DC current. This is technically a Taylor approximation, since

$$i_D(v) = i_D(V_D + \Delta V) \approx I_D(V_D) + \Delta V \frac{di}{dv}\Big|_{v=V_D}$$