Midterm 1 Review

Current is flow of electric charge/sec \[ i(t) = \frac{dq(t)}{dt} \] \[ \text{Amps} = \text{Coulombs/sec} \]

Voltage is energy/unit-of-charge \[ v \]

Power : \[ p = v \cdot i \] \[ > 0 : \text{energy is absorbed} \]
\[ < 0 : \text{energy is supplied} \] \[ \text{Watts} = \text{J/s} \]

Energy : \[ W = \int_{t_1}^{t_2} p(t) \, dt \] \[ \text{Joules} \]

\[ V = I \cdot R \]
\[ R = \frac{PL}{A} \] \[ \text{Resistance is proportional to resistivity} \]
\[ G = \frac{1}{R} \] \[ \text{`Conductance`} \]
\[ I = GV \]

Equivalent Resistances:

Series Resistors:
\[ R_{eq} = R_1 + R_2 + \cdots + R_n \]

Parallel:
\[ R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}} \]

Voltage Divider (series)
\[ V_1 \frac{R_1}{R_1 + R_2 + R_3} \]
\[ V_2 \]
\[ V_n = \frac{R_n}{R_1 + R_2 + \cdots + R_n} \cdot V_s \]

Current Divider (parallel)
\[ I_1 \frac{R_1}{R_1 + R_2} \]
\[ I_2 \]
\[ I_2 = \frac{R_1}{R_1 + R_2} \cdot I_s \]

Node-Voltage Analysis (KCL)
- supernodes around Voltage Sources
- dependent sources

Mesh-Current Analysis (KVL)
- supermesh around Current Sources
- dependent sources
Thevenin Equivalent Circuit

\[ V_T \quad (+) \quad U_{oc} = V_T \]

\[ I_N = \frac{V_T}{R_T} \]

The two are interchangeable (Source Transformations)

- **Thevenin**
- **Norton**

a) Find \( U_{oc} \)
b) Find \( I_{sc} \)
c) Find \( R_T \)

- **Dependent sources require additional eqn**
  - if no independent sources, you must excite ckpt with a 1V (or 1A) test voltage (or current). \( R_T = \frac{V_{test}}{I_{test}} \)

Zeroing of independent sources

- Voltage-source becomes short ckpt (\( \sigma \) volts)
- Current-source becomes open ckpt (\( \sigma \) amps)

Source Transformations

\[ V_T \quad (+) \quad U_{oc} \]

\[ I_N = \frac{V_T}{R_T} \]

Max Power Transfer

- occurs when \( R_L = R_T \) \( P_{l_{max}} = \frac{V_T^2}{4R_T} \)

= load resistance that absorbs maximum power

Superposition Principle

The net response in a linear circuit is equal to the sum of the responses from each independent source acting alone (with all other independent sources zeroed),