EXAM REVIEW TOPICS:

Lecture 2:

* What is current?
  * Sign convention
  * Positive and negative charge
  * AC versus DC

* What is voltage?
  * How is it related to energy?
  * What is the “ground” potential?
  * What is the physical ground “plane” versus the reference node?

* Power?
  * Passive sign convention
  * Energy

* Components
  * Sign convention of voltage/current
  * Sign convention of power

* Voltage Source
  * Ideal voltage source
  * Real battery
  * Internal resistance/ source resistance

* Ideal switch
  * voltage/current /power

* From Physics: KCL/KVL
* Battery packs (homework)

Lecture 3:

* Conductors
  * Ideal conductors
  * Real conductors
  * Ohm’s law
  * Calculating resistance
  * Conductance
  * Power loss in conductors
  * Strain gauge as an example

* Resistors as modeling elements
  * Light bulb
\[ V_{oc} = V_{int} = 1.2V \]
\[ R_i = 0.65\Omega \]

\[ I_{max} = \text{?} \]
\[ V_{oc}' = 2.4V \]
\[ R_i = 0.65\Omega + 0.6\Omega \]
\[ = 1.2\Omega \]
\[ I_{max} = \frac{V_{oc}}{R_i} = 2A \]

**Thevenin:**
- Zero out independent sources
- Find \( R_{TH} \)

\[ R_i' = 0.35\Omega \]
\[ I_{max}' = \frac{V_{oc}'}{R_i'} = \frac{1.2V}{0.35\Omega} = 4A \]
* Motor
* Antenna
* Speakers
* Anything passive!

* Energy loss in power delivery
  * High voltage versus high current
  * Need for transformers / AC

* Resistors
  * Series resistors
  * Parallel resistors

**Lecture 4:**

* Current source
* Dependent sources versus independent sources
* Resitive dividers
  * Voltage dividers
  * Current dividers
  * Shorts and opens/Winners and losers
* Variable resistors/Pots
  * Efficiency of divider circuits

**Lecture 5:**

* Nodal analysis
  * counting nodes
  * reference node
  * eliminating nodes
    * super nodes
    * trivial nodes
  * Nodal without dependent sources
  * Nodal with dependent sources
  * Knowns versus unknowns
  * Setting up equations in standard form (LHS = RHS)
    * LHS = unknowns
    * RHS = knowns

**Lecture 6:**

* Linearity and Superposition
* Thevenin Equivalent
  * Voc and Isc
  * “Req” approach without internal sources
Count Nodes: A, B, C, D

Define a REF Node: Node D ⇒ Result in eliminating other nodes.

Unk V_c

Identify Super Nodes:

- Floating Voltage Source
- Group of Connected Voltage Source

Write KCL Eq ⇒ for every unk node
\[ V_{\text{out}} = -\frac{R_2}{R_1} \cdot V_{\text{AV010}} \]

\[ \eta = \frac{R_{\text{SPMN}}}{R_{\text{SPMN}} + R_{\text{pot}}} \]
\[ R_2 \parallel R_1 \]
\[ V_1 + IR_2 + V_2 + IR_1 = 0 \]
\[ I = -\frac{(V_1 + V_2)}{R_1 + R_2} \]
\[ V_x = IR_2 = - (V_1 + V_2) \frac{R_2}{R_1 + R_2} \]

**Superposition**

\[ V_2 = 0 \]

\[ V_x = -V_1 \cdot \frac{R_2}{R_1 + R_2} \]
\[ I_x = g_m V_x \]
\[ R_{th} = \frac{V_x}{I_x} = \frac{1}{g_m} \]

\[ \frac{1}{g_m} \]
\[ V_1 + V_2 \]

\[ I_1 + I_2 \]

\[ I_1 \neq I_2 \]
Lecture 7:

* Amplifiers
  * Terminals
  * Signal pins versus power pins
  * Gain
  * Ideal vs. Real
    * Input R / Output R
  * Equivalent circuit
  * Loading
    * Dividers at input / output
    * Effective gain
    * Cascade
  * Dynamic Range
    * Clipping
* Types: CC, VV, CV, VC
  * Most common is voltage/voltage
\[ R_L = R_S \]

\[ \eta = \frac{P_L}{P_L + P_S} = \frac{I^2 R_L}{I^2 R_S + I^2 R_L} = \frac{R_L}{R_S + R_L} = \frac{R_S}{2R_S} = 50\% \]

\( \Rightarrow \) Maximum power extracted.