HKN ECE 110 Review Session Exam 2

COREY SNYDER

First things first…

- HKN Peer Mentoring
  - Tuesday and Wednesday (3/27 & 3/28) from 10am-4pm in the ECEB Atrium
  - Come ask questions about course registration, internships, and general advice!

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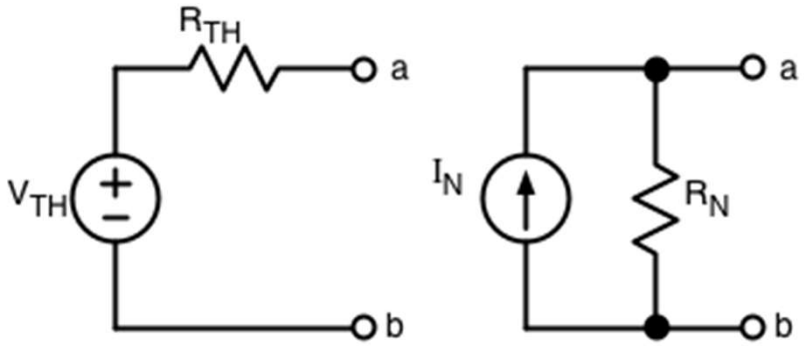
- Notes for your Exam:
  - You can bring a note sheet, 8.5x11” double-sided
  - Don’t forget about office hours! The schedule is pinned to the top of the ECE 110 Piazza and on the course website under the “Office Hours” tab
  - There is a practice exam available for Exam 2 on Prairielearn. Use this to prepare for the exam and make up some homework points!

Thevenin and Norton Equivalents

- We can express any linear circuit as a simple circuit involving a source and a resistor (Wow)
  - More on this in ECE 210!
- We want to find V_{oc}, I_{sc}, and R_{eff}
- If we find two of these parameters, we can find the third through Ohm's Law!
- If current is defined as standard: (I goes from "+" to "-" through V)
  - $I = \frac{-I_{SC}}{V_{OC}} V + I_{SC}$
- If current is defined as non-standard:
  - $I = \frac{I_{SC}}{V_{OC}} V - I_{SC}$



Thevenin and Norton Equivalents

- There is a lot of vocabulary with Thevenin and Norton Equivalents, and this can be confusing! Keep the following things in mind:

$$I_{sc} = I_N$$
$$V_{oc} = V_T$$
$$R_T = R_N = R_{eff} = R_{eq}$$

- Remember what each parameter represents in the IV characteristic and the corresponding graph.
- I_{sc} is the y-intercept
- V_{oc} is the x-intercept
- $\frac{1}{R_{eff}}$ is the **magnitude** of the slope. Remember the sign is determined by whether the current definition is standard or non-standard

Node Voltage Method

- We want to express KCL in terms of node voltages using Ohm's Law. How do we do this?

1. Pick a ground node that touches as many sources as possible.
2. Label the nodes that touch ground through a voltage source.
3. Pick a node where you need to find the node voltage. Write KCL at that node.
4. Express each current using Ohm's Law and the node voltages. Be careful of your current directions. We express each current as the voltage "where you start" minus the voltage "where you end" with respect to the current direction, divided by the resistance.

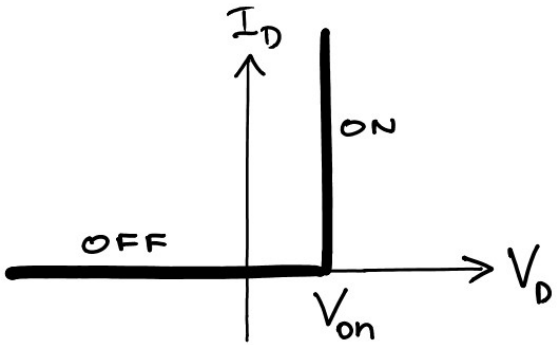
$$I_x = \frac{V_{start} - V_{end}}{R_x}$$

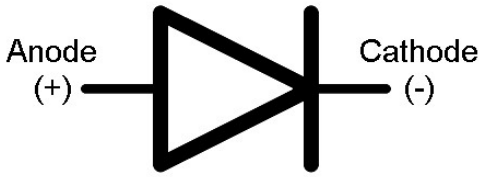
5. Solve! (May need a system of equations if there is more than one unknown node)

- Supernodes
  - Useful when we have a floating voltage source (i.e. a voltage source that has no reference/is not grounded)

Diodes

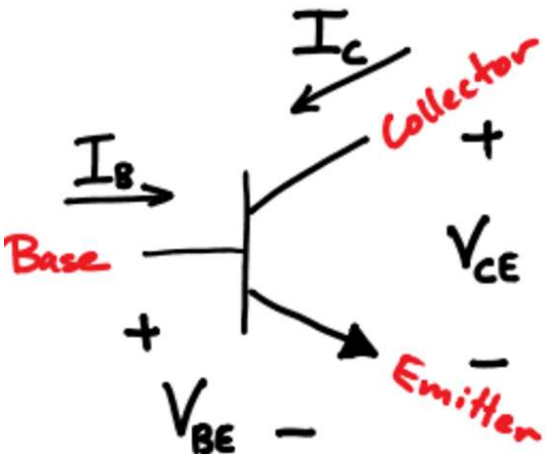
- Diodes are non-linear devices that allow current to pass in only one direction
- Offset-Ideal Model
- How do we know if a diode is on? Guess and Check!
- If we guess off, we say the current is zero and $V_D < V_{on}$
- Guess on, positive current flows and V_{on} volts are across diode
- If our guess is wrong, one of these conditions will be violated
  - E.g. We guess on, but reverse current flows through the diode
- Clipper circuits





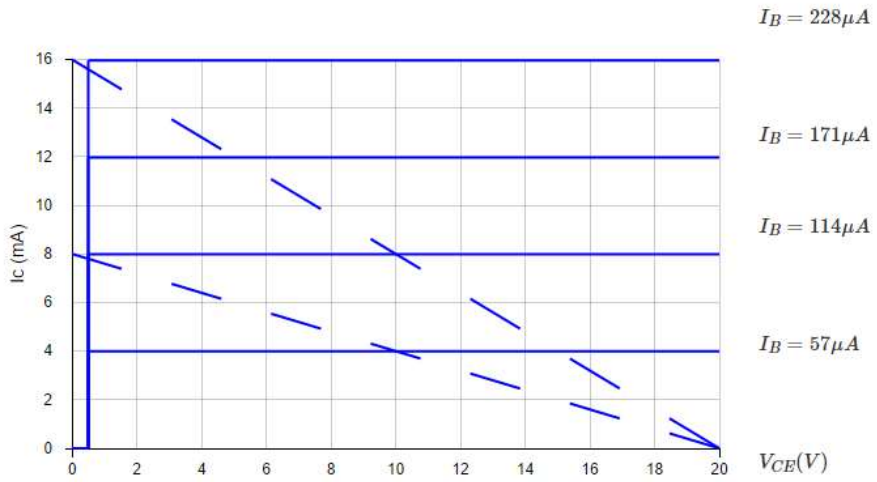
Bipolar Junction Transistor (BJT)

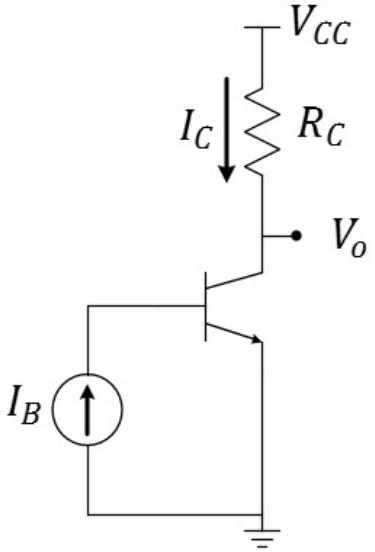
- Three terminal device: Base, collector, emitter
- $V_{BE,ON}$ and $V_{CE,SAT}$ are properties of the BJT (ECE 340!)
- In ECE 110 we consider the Common-Emitter (CE) configuration
  - For more on this, take ECE 342!
- Three regions of operation: Off (Cutoff), Active, Saturation
- Off: $V_{BE} < V_{BE,ON}$, all currents are zero!
- Active: $V_{BE} > V_{BE,ON}, I_C = \beta I_B$
- Saturation: $V_{BE} > V_{BE,ON}, V_{CE} = V_{CE,SAT}, I_C \neq \beta I_B$!



BJT IV Characteristics

- The solid lines represent the IV characteristics of the BJT. Note that the IV characteristic depends on the bias conditions: the value of I_B
- The dotted line represents the IV characteristic of the right-hand loop: the collector side





Concise Advice to Make Your Grade Look Nice

- Use your note sheet in order to study and collect your thoughts on each of the topics
- Do not spend too much time on questions you cannot answer
- Spend your time showing what you know
- Take time to relax before your exam
- **Do not rely too much on the practice exams**