

Electronics Exam Review
ENGN/PHYS 208—Winter 2019
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Digital Logic Gates

1. Transistor-resistor realization of logic gates, and applying Ohm's law to solve for the output voltage
2. Know by heart the truth tables for all basic logic gates: Not, And, Nand, Or, Nor, Xor. Nice summary table on this AI blog and similarly in this figure

Practical Stuff

- (a) Logic levels in practical devices: V_{OH} , V_{IH} , V_{OL} , V_{IL} . Great Sparkfun tutorial/refreshers here
- (b) Pull-up and pull-down resistors for digital switching. Good refresher tutorials on Arduino playground here and Sparkfun here
- (c) Tri-state buffers: what are the 3 possible states?

Binary Number Systems

1. Decimal
2. Binary
3. Hex

Know how to compute with and convert between these number systems. Dr. Valvano at UT-Austin publishes a very nice interactive website with practice problems, refer as needed.

Basic Memory Elements

1. SR latch
2. D latch
3. Triggering: level vs. edge triggered

Know how these basic memory elements operate to store single bits of information.

RAM and Flash

1. Volatile vs. non-volatile memory
2. How are RAM and Flash used (in very different ways) inside a microcontroller

3. RAM: can write to memory or read currently stored contents in any cell. Be able to look at diagram showing address lines, data lines, and understand what read/write (R/W) operation occurs
4. Flash memory
 - (a) Basic enhancement mode MOSFET operation: How does current flow (or not) from Drain to Source based on state of the Gate.
 - (b) Floating gate in Flash memory cell—what is its critical role in memory storage?
 - (c) How do reads work via the screening effect and change in threshold voltage?
 - (d) How is the cell erased and written using Quantum tunneling and hot-electron injection?
 - (e) Why does flash have a limited lifetime; what damages the memory cells?

Analog-Digital Converters

1. ADC vs. DAC operation.
2. Resolution: how many bits, how much dynamic range?
3. Practical stuff: converting analog reads to actual voltages, e.g. `float voltage = analogRead(A0)*5.0/1023/0;`
4. Sampling rate: bandwidth, aliasing, and the Nyquist theorem; rule of thumb for accurately recording an underlying signal.

Microcontroller Practical

You should feel comfortable with basic programming and usage with an Arduino Uno R3 microcontroller. You should feel comfortable starting with a template of code, and modifying it for a specific purpose, running the code, viewing the output and making sense of it.