

ECE 2500 Spring 2012

LECTURE SUBJECT TITLES

Subject Sequence	Marcovitz Textbook Reading Assignment
The Digital World	Howstuffworks.com
Number System Conventions	1.1-1.3
Boolean algebra	2.2-2.4, 2-7-2.8
Logic Gates and Circuits	2.6
minterms and K-maps	2.5, 3.1
Maxterms and Kmaps	3.2-3.4
Important types of CLCs	4.2-4.5
ROM, PLD & RAM Structures	4.6
Sequential Logic Circuits	5.1-5.2
Flip-flops and Clocks	5.3
Sequential logic circuit analysis and design	6.1-6.4
Important Types of SLCs	7.1-7.3

THE DIGITAL WORLD

Notes:

Major Application of Digital Logic: the design of microprocessor chips in computers & mobile devices.

iPod Architecture

From: electronics.howstuffworks.com/ipod3.htm

1. Microprocessor chip
2. Memory (SDRAM 256 MB)
3. Peripherals
 - a. Click Wheel (capacitive sensing controller)
electronics.howstuffworks.com/ipod4.htm
 - b. Hard drive (30 GB)
 - c. Display (320 x 240 pixel LCD)
electronics.howstuffworks.com/lcd2.htm
4. **iPod Touch** differences
 - a. Smaller electronics
 - b. Touch display (480 x 320 pixel x 2)
electronics.howstuffworks.com/ipod-touch2.htm

Digital Data Types

1. **Numeric**
 - a. Integer
 - i. Unsigned (count values)
 - ii. Signed (add or subtract)
 - b. Floating Point
 - i. Radix (decimal) points
 - ii. Sign, fraction & exponent
 - c. BCD (binary-coded decimal)
2. **Nonnumeric**
 - a. Characters
 - i. ASCII: 1 B for each of $2^8 = 256$ English and control characters (Latin-1)
From: howstuffworks.com/bytes2.htm
 - ii. UNICODE: 2 B for each of $2^{16} = 64K$ International characters.
 - b. Audio
 - i. Analog waveforms
From: howstuffworks.com/analog-digital2.htm
 - ii. A/D Conversion to 16 bits (CD)
From: howstuffworks.com/analog-digital3.htm
 - iii. Compression.
From: computer.howstuffworks.com/mp32.htm

B = byte = 8 bits (b)

K = $2^{10} = 1024 \approx 10^3$

$2^9 = 512$

$2^8 = 256$

... etc.

M = K x K = $2^{20} \approx 10^6$

G = K x M = $2^{30} \approx 10^9$

A *motherboard* is where all the circuit components are mounted. Major components are connected by *bus* ribbons.

One large square chip is numbered PP5020E. [Google](#) this number and see if you can identify this chip.

Open a text file and type: "ECE 2500". When you save the file, find the size of the file in bytes. It should be 8 B.

It is estimated that there are about 200,000 international characters. UNICODE can handle only $\frac{1}{4}$ of them.

Codecs such as **MP3** or **AAC** (iPod) use *psycho acoustics* and *perceptual coding* to compress the file to 10% of its original size.

Color codes

From: howstuffworks.com/lcd5.htm

- iv. Red 1 B => 256 shades
- v. Green 1 B => 256 shades
- vi. Blue 1 B => 256 shades

The total number of possible shades of colors with a 24 bit color format is:
 $256^3 = 2^{24} = 16 \text{ M colors}$

Digital Logic Components (Process digital data)

1. **Register** (holds various forms of digital data)
2. **Port** (a register interfacing data to/from the outside world)
3. **ALU** (adds contents of 2 registers)
4. **Bus** (A path by which data may flow from one register to another in parallel)
5. **Encoder** (Encodes or compresses data)
6. **Decoder** (Decodes or expands data. Also used to make memory location selections)
7. **MUX** (Selects between many data sources)
8. **ROM** (An storage array that can be read word by word, chosen by an address)
9. **RAM** (A storage array that also can be written)
10. **USB cable** (A path by which data packets may be transferred serially to ports from a hub)
11. **Optical Disc Storage** (CD/DVD ROM from which blocks of data can be read)
12. **Hard Disk Drive** (A magnetic storage device from which blocks of data can be stored & read)
13. **USB drive** (A ROM device which can transfer data in blocks over a USB cable)
14. **Microcontroller** (A processing device consisting of an ALU, registers, ports and RAM)
15. **Microprocessor** (More powerful processor that has extensive memory and multiple ALUs)
16. **LCD display** (a display device which uses a 2d decoder array and a controller)

NUMBER SYSTEM CONVENTIONS

Number systems table: comparison of important number systems, including:

1. **decimal** (base 10)
2. **binary** (base 2)
3. **octal** (base 8), and
4. **hexadecimal** (base 16) number systems

Octal and hexadecimal are encodings of groups of binary #s.