Survey of Electronics

• Introductions
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• Syllabus and Learning Module Review

• Course materials
  • Brief History of Electronics
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Survey of Electronics

• Introductions
  • Students
  • Instructor

• Syllabus and Learning Module Review
  • Contact Info
    • WEB Page: sites.csn.edu/jmiller
      • Every one log-on and go to the site
    • Office and Office Hours
      • CY 2713
      • Office hours listed on Web Page
    • joseph.miller@csn.edu
Survey of Electronics

• Syllabus and Learning Module Review
  • Text Books:
    • None required
    • But you will need WEB Access
      • Either from home or Open-Computer Labs at all major campi and at all Tech Centers
  • Outcomes
    • Per paper copy
  • Weekly Assignments
    • Per paper copy
Brief History of Electronics

• Static Electricity
  • Ancient Greeks noticed that if they rubbed a piece of amber, feathers would stick to it.
    • You’ve experienced a similar thing if you’ve ever had your hair stick up straight after you combed it
    • Or had your socks stick together when you removed them from the drier
  • In 1660 German Otto von Guericke made the first electrostatic generator with a ball of sulfur & some cloth.

• Storage of Static Electricity
  • *Leyden jar.*
    • Pieter van Musschenbroek of Leyden, Holland.
Brief History of Electronics

• **Static Electricity**
  - **Storage of Static Electricity**
    - *Leyden jar.*
      - In 1746 he wrapped a water-filled jar with metal foil and discovered that this simple device could store the energy produced by an electrostatic generator.
      - In 1752 Ben Franklin proved that Lightning was electricity using a Leyden jar.

• **Batteries**
  - Developed by Italian Alessandro Volta in 1799

• **Electromagnets and Induction**
  - 1820 Danish physicist Hans Oersted showed:
    - Current through a wire, produces a magnetic field around wire.
Brief History of Electronics

• Electromagnets and Induction
  • British scientist Michael Faraday
    • When you move a loop of a wire in a magnetic field, a little bit of current flows through the loop for just a moment.
      • This is called induction.
    • Faraday constructed a version of it called the induction ring. Ref: http://micro.magnet.fsu.edu/electromag/java/faraday/
    • Michael Faraday demonstrated a electric motor.
    • In 1834 Thomas Davenport designed a motor that was strong enough to run a small printing press
  • John Henry developed a electro magnet
    • It could do heavy work, such as lifting hundreds of pounds of metal. With his demonstration
    • Henry really began to transform electricity into something that people could use every day.
**Brief History of Electronics**

- **Communications**
  - **Telegraph**
    - However, the most successful practical early use of electricity in the 19th century was a simple communication device called the telegraph.
    - This new form of communication ushered in the era of electrical communication and brought electricity to the forefront of the public’s attention.
    - In 1837, English scientist Charles Wheatstone opened the first commercial telegraph line between London and Camden Town, a distance of 1.5 miles.
    - Building on Wheatstone's ideas, Samuel Morse, an American artist and inventor, designed a line to connect Washington, DC and Baltimore, Maryland in 1844.
Communications

• Telephone
  • In 1875, Bell discovered a way to convert sound waves to an undulating current that could be carried along wires.
  • This helped him invent the telephone.
  • At first, telephones were connected in pairs.
    • You could call only one person, and they could only call you.
  • First exchange was in 1878.
  • In 1891 an automatic exchange was invented.

This experimental telephone was demonstrated by Alexander Graham Bell in 1876. It uses the interaction between an electromagnet and a diaphragm to convert sound waves into electrical signals and back again. A person speaking into the transmitter causes the parchment diaphragm to vibrate. Mounted in the center of the diaphragm is a metal button (seen in the photo). As this button vibrates within the field surrounding the electromagnet, it causes fluctuations in the current moving through the electromagnet. The fluctuating current travels through a telephone wire causing matching fluctuations in the receiver’s coils. These cause the receiver’s diaphragm to vibrate, thus reproducing the original sound.

Courtesy: Smithsonian Institution.
• Communications
  • Telephone
    • Long Distance
      • Main problem was that the signal weakened with distance, disappearing if the telephone lines were too long.
      • A solution was found in 1912 with a way to amplify electrical signals, and transcontinental phone calls were possible.
      • A test took place in 1914, and the next year,
        • Bell, who was in New York, called Watson, who was in San Francisco.
        • He said the same thing he had said during the first phone conversation. Watson’s answer?
        • “It will take me five days to get there now!”
Brief History of Electronics

• Power and Light
  • Incandescent lighting—where an electrical current causes a filament to glow—not invented by Edison.
    • The problem was that the light lasted only a few minutes because the filaments burned out.
  • Edison found a way around that.
    • In 1879 he came up with a workable filament that allowed light bulbs to burn much longer.
• Power Generation
  • In 1882, Edison opened the Pearl Street station in New York City.
Brief History of Electronics

• Power and Light
  • Power Generation
    • Pearl Street station was the world’s first commercial power plant.
      • Although it was an enormous plant for its day,
        • The station at Pearl Street was able to produce and distribute electricity to only one square mile of lower Manhattan.
        • It used direct current (DC), which was not ideal for delivering electricity over long distances.
        • AC is much better
  • AC Motors
    • Nikola Tesla invented a practical AC motor in 1883.
  • AC Power Generation
    • AC power plant opened at Niagara Falls in 1895 and was used to light up portions of Buffalo, New York
Brief History of Electronics

• Power and Light
  • Use of AC Power
    • In 1908 the vacuum cleaner came on the market
    • In 1913 electric refrigerator possible.
    • In 1935 the clothes dryer was invented.

• Radio
  • Radio wave
    • Radio began in 1888 when German physicist Heinrich Hertz demonstrated the existence of radio waves
    • Radio waves, also called electromagnetic waves
  • Marconi
    • Marconi thought electromagnetic waves could be used to transmit signals.
      • First, Marconi was able to transmit Morse Code only a few miles.
      • But in 1901 he built a transmitter strong enough to send messages across the Atlantic Ocean. This was the beginning of wireless communication. It was even faster than the telegraph and, best of all, no expensive wire or cable had to be laid.
Brief History of Electronics

• Radio
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  • Music and Voice transmission
    • 1906, Reginald Fessenden transmitted the first music and voice program.
      • It originated in Massachusetts and was received in Virginia.
  • Westinghouse was granted the first United States broadcasting license for its station, KDKA, in October of 1920
    • On 2 November 1920 KDKA held the first scheduled public broadcast
Brief History of Electronics

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    • Used AM broadcast
Brief History of Electronics

• Radio
  • **FM** (frequency modulation)
    • In the 1930s Edwin H. Armstrong developed FM
    • In 1947 the invention of the transistor also made it possible to combine AM and FM radios into a single, small package.
      • 1954 the [first transistor radio](http://www.regencytr1.com/) (Regency TR-1) was produced with the help from Texas Instruments
        
• Broadcast Radio
  • By the 1940s, radio broadcasting was a powerful
  • The programming on radio was a lot like today’s TV, with news, sports, dramas, comedy shows, and soap operas—not to mention commercials.
  • Just as people today spend their evenings glued to the television, people gathered in their living rooms to listen to the radio.
Brief History of Electronics

• Television (TV)
  • In the late 19th century people began thinking about ways to transmit moving pictures
    • German Paul Nipkow received the first patent for a TV-like machine in 1884.
      • Mechanical device
    • Scotsman John Logie Baird began experimenting with Nipkow system and created a better mechanical system.
      • He even invented the first video recording system.
      • Baird had some success in the 1920s
    • By the mid-1930s everyone, including Baird, knew mechanical TV could not compete with the emerging electronic systems.

• Electronic systems
  • By 1936 RCA created the National Broadcasting Corporation (NBC), the first American TV network
    • First broadcast at the 1939 World’s Fair
Brief History of Electronics

• Television (TV)
  • Electronic systems
    • By the early 1950s television and its programming,
      • Such as sports, game shows, and dramas, had taken hold of the public’s attention
  • Improvements
    • Color TV developed in the 1950s – became popular in 1960s
    • HDTV
      • Standard developed in 1993
      • First experimental broadcast in 1994
      • US analog broadcasts end in 2009 – Only HDTV will be available
    • IPTV
      • Quality is improving

• Transistors and Chips
  • Transistor invented in 1947 at Bell Labs
    • John Bardeen, Walter Brattain, and William Shockley
Brief History of Electronics

• Transistors and Chips
  - The transistor was used to amplify electrical currents.
    - Before it was developed, *electron tubes* (also called vacuum tubes) were common.
      - But they were too large and delicate for many uses.
    - The transistor was small, cheap, and efficient.
      - It had all sorts of applications, from airplane guidance systems to transistor radios.
  - Integrated Circuits (ICs)
    - Developed independently in 1958 by Robert Noyce and Jack Kilby

Jack Kilby of Texas Instruments made this, the first integrated circuit, in 1958. At virtually the same time Robert Noyce also developed an integrated circuit. Courtesy: Texas Instruments
Brief History of Electronics

• Transistors and Chips
  • Integrated Circuits (ICs)
    • Today, one silicon chip can have hundreds of millions of transistors, resistors, capacitors, and conductors on it
    • Gordon Moore (one of the founders of Intel on ICs - Ref http://cnettv.cnet.com/life-span-moore-law-even-amazes-author/9742-1_53-29924.html

Computers

• Computers were originally used only for mathematical calculations—that’s why they’re called computers.
• Charles Babbage and Ada Lovelace designed one of the first computers in the 1800s, which was a purely mechanical device.
• Electronic Numerical Integrator and Computer, or ENIAC
  • First full-scale general purpose electronic digital computer
Brief History of Electronics

• Computers
  • Electronic Numerical Integrator and Computer, or ENIAC
    • First full-scale general purpose electronic digital computer
    • Built in the early 1940s by John Mauchly and J. Presper Eckert at the University of Pennsylvania.
    • Built it to calculate ballistic tables for the military
      • Data were recorded on punched cards (usually known as IBM cards), and input to the computer using a card reader.
      • Took up a whole huge room!
  • The military also began to be a major user of computers in the 1950s and afterward.
    • The SAGE system, for example, used a computer to coordinate an enormous radar system.
    • SACCS system was used to coordinate potential deployment of the Strategic Air Command
brief history of electronics

• computers

  • for a long time computers were used only by universities, corporations and the government because they were large and expensive

    • that started to change when intel developed the first microprocessor in 1971

• microprocessors

  • put computers into other sorts of machines, such as industrial robots, home appliances, and video games.

  • most famous early video game, called pong, was introduced in 1972.

the intel 4004 microprocessor, which was introduced in 1971. the 4004 contained only 2300 transistors and performed 60,000 calculations per second. courtesy: intel.
Brief History of Electronics

• Computers
  • Microprocessors
    • It wasn’t until 1977 that microprocessors were used in the Apple II.
      • This was the first successfully marketed personal computer in a long line of machines that have changed the way we live.

• Lasers, Fiber Optics, and Other Bright Ideas
  • Lasers (Light Amplification by the Stimulated Emission of Radiation)
    • In 1958 physicists Charles Townes and Arthur Schawlow published a paper describing how a laser could be built.
Brief History of Electronics

• Lasers, Fiber Optics, and Other Bright Ideas
  • Lasers (Light Amplification by the Stimulated Emission of Radiation)
    • Townes and Schawlow came up with the idea and received a patent for it in 1960.
    • Theodore Maiman, who built the first working laser in 1960
      • Maiman used ruby to build his laser. Other scientists thought ruby wouldn’t work, but they were wrong.
      • By 1961 commercial lasers began to be produced, made of all kinds of materials.
  • Used for:
    • Precise cutting in medicine and manufacturing
    • In communications,
    • In scientific research
    • In devices like compact disk players, and printers,
    • In the scanners used at supermarket checkouts.
Brief History of Electronics

• Lasers, Fiber Optics, and Other Bright Ideas

• Fiber Optics
  • Are long, super thin strands of glass
  • Used to transmit light over long distances
  • They’re used in telecommunications—things like telephone lines—because they’re cheaper, more efficient, and take up less space than the copper wires
Careers in Electronics

• As the heirs to Faraday's, Fleming’s and many others work, today's electrical, electronics, and computer engineers, technologists, and technicians continue to revolutionize the way we live.
  • We depend on the hundreds of thousands of these individuals who design, produce, operate and maintain a vast array of equipment and services.
  • This course will concentrate on Technicians since CSN offers Associate degrees that prepare technicians
    • See the following Web page for a discussion of engineering careers
    • http://www.ieeeusa.org/careers/yourcareer.html
Careers in Electronics

As the heirs – continued

- CSN’s Degrees in areas of electronics:
  - Telecommunications
  - Slot Technology
  - Electronics
  - Networking and Internetworking
  - Network Security

- While technicians are not usually responsible for designing products or systems, job satisfaction comes from "hands-on" involvement with these products and systems. Technicians typically install, test, and maintain products in the field and are integral to the manufacturing process.
Careers in Electronics

• Typical job titles for technicians include:
  • Service Technician
  • Manufacturing Specialist
  • Field Service Technician
  • Customer Service Representative
  • Test Technician
  • Bench Technician
  • Calibration/Lab Technician
  • Slot Technician
  • Slot Bench Technician
  • Network Engineer
  • Network Manager
  • Security Manager
Careers in Electronics

- Additional Factors Affecting Your Career
  - Size and kind of company you want to work for.
    - In a small organization you may have several responsibilities.
      - Restricted capital resources and the small number of employees
        - Often balanced by the speed with which decisions can be made
          and by the impact of individual ideas or abilities.
    - In a large corporation
      - Virtually all categories of positions are found
      - There is a greater opportunity to specialize in an area of interest.
      - Large corporations offer a larger number of training programs,
        greater stability, and more capital and equipment support.
      - Larger companies move more slowly than smaller companies.
  - Pay in LV area usually starts at about $20/hr for technicians
Common Electronics Components

• There are a great variety of different electronics parts aka components used in devices
  • Quick overview – Reference page
    http://zeus.cedcc.psu.edu/comp_id_tool.html

• Resistors
  • Overview http://en.wikipedia.org/wiki/Resistor
  • Symbols on the right
Common Electronics Components

• Capacitors
  • **Overview**
    http://www.kpsec.freeuk.com/components/capac.htm
  • **Symbols to the right**
Common Electronics Components

• Inductors
  • Symbol to the right

[A choke with two 47mH windings, such as might be found in a power supply](http://en.wikipedia.org/wiki/Inductor)
Common Electronics Components

• **Switches**
  
  • [Overview](http://en.wikipedia.org/wiki/Switch)
  
  • **Some symbols to the right**

Electrical switches. Top, left to right: circuit breaker, mercury switch, wafer switch, DIP switch, surface mount switch, reed switch. Bottom, left to right: wall switch (U.S. style), miniature toggle switch, in-line switch, push-button switch, rocker switch, micro-switch
Common Electronics Components

• Diodes
  • **Overview**
  • Standard and LED types
  • **Some symbols to the right**
Common Electronics Components

• Transistors
  • Overview
  http://en.wikipedia.org/wiki/Transistor
  • Some symbols to the right
    • JFETs and bipolar junction transistor
      • Both N and P types

Common Emitter Amp
Common Tools

• Some common tools
  • Meters used for basic measurement of voltages, currents, and components in or out of the circuit under test.
    • Voltmeter (measures voltage)
    • Ammeter (measures current)
    • Ohmmeter (measures resistance too current flow)
    • Multimeters - e.g., VOM (Volt-Ohm-Milliammeter) or DVM (Digital "Volt" Meter) (Measures all of the above)
  • The following are used for stimulus of the circuit under test:
    • Power supplies
    • Signal generator
    • Pulse generator
Some common tools

- The most critical aspect is the test probes and other wiring needed to power and test the circuits.

- **Analyzers**
  - Oscilloscopes (Measures all of the above as they change over time)
  - Frequency counters (Measures frequency of signals)
  - Logic analyzer (Tests digital circuits)
  - Spectrum analyzer (SA) (Measures spectral energy of signals)
  - Vector signal analyzer (VSA) (Like the SA but it can also perform many more useful digital demodulation functions)
  - Time-domain reflectometer for testing integrity of long cables

Common Tools

• Some common tools
  • Pictures

- Benchtop Digital Multimeter
- Portable Multimeter
- Oscilloscope
- Current Probe