HANDOUT S03-003

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

6.002 – CIRCUITS AND ELECTRONICS
SPRING 2003

STATEMENT OF OBJECTIVES AND OUTCOMES

COURSE OBJECTIVES

After successfully studying 6.002, students will be able to:

1) Understand the basic electrical engineering abstractions on which the analysis and design of electrical and electronic circuits and systems are based. These include the lumped circuit abstraction, the digital abstraction and the operational amplifier abstraction.

2) Use these abstractions to analyze and design simple electronic circuits.

3) Formulate and solve differential equations which describe the behavior of circuits containing energy storage elements.

4) Understand the concepts of employing models of complex devices, and use simple models to represent active and non-linear elements, such as semiconductor diodes and field-effect transistors in circuits.

5) Construct circuits and use laboratory tools including oscilloscopes, signal generators and multimeters to take measurements of circuit behavior and performance. Compare measured behavior with that predicted by the analysis of circuit models and explain the discrepancies.

LEARNING OUTCOMES

1) Employ **elementary circuit models** for resistors, sources, inductors, capacitors, diodes and transistors in circuits.

2) Analyze circuits comprised of linear lumped elements using **nodal analysis.**

3) Employ linear circuit theorems including **superposition and Thevenin and Norton equivalent circuits.**

4) Employ Boolean algebra to describe the function of **logic circuits.**

5) Design circuits using transistors to implement digital logic functions. Specifically, **design digital circuits** to implement specified Boolean functions.

6) **Build digital logic circuits** in the laboratory and verify experimentally their behavior.

7) Ensure that **noise margins and the constraints of the static discipline** are met in digital gates.

8) Use the graphical technique of **load line constructions** to analyze the behavior of circuits containing non-linear elements. Employ circuit models which use **nonlinear dependent sources.**

9) Develop and employ in circuit analysis **incremental or small-signal models containing dependent sources** to represent the behavior of non-linear elements.

10) **Build a single stage amplifier**, establish an appropriate operating point, measure its gain and transient response.

11) Use capacitor models and first-order differential equations to **model delays in digital gates**.

LEARNING OUTCOMES (CONT.)

12) Analyze the time behavior of first- and second-order circuits containing models **of energy storage elements**.

13) Employ **singularity functions** and superposition to represent complex input time functions.

14) Analyze the behavior of first and second order linear circuits in **the sinusoidal steady state**. Determine the frequency response of circuits.

15) **Use complex impedances** to determine the frequency response of circuits and employ **Bode diagrams** to visualize the behavior of driving-point function and transfer functions.

16) Determine energy flows in second-order circuits and employ the concept of Q - the **quality factor of a resonant circuit.**

17) Determine in the laboratory the time-domain and frequency-domain behavior of an **RLC circuit**.

18) Use **operational amplifier models** in circuits which employ **negative feedback**. Analyze amplifier and filter response and stability.

19) Analyze the response of operational amplifier circuits which employ positive feedback to create **oscillators and clocks.**

20) Determine **static and dynamic power dissipation in digital gates and employ complementary gate technology** to reduce static losses.

21) **Design build and test an audio playback system** which takes input from a digital storage device, including the clock, the D/A converter, and an amplifier.