Digital Applications (CETT 1415)

Credit: 4 semester credit hours (3 hours lecture, 4 hours lab)

Prerequisite: CETT 1403 & CETT 1405

Course Description

This course covers digital techniques and numbering systems, digital logic circuits, digital integrated circuits, decoders, encoders, multiplexers, demultiplexers.

Required Textbook and Materials

1. *Digital Electronics 9th Edition* by William Kleitz, Pearson/Prentice Hall
    a. ISBN number is 13:978-0-13-2543033
2. Flash Drive – 1GB Minimum
3. Notebook.

Course Objectives

Upon completion of this course, the student will be able to:

1. Demonstrate a working knowledge of digital quantities with emphasis on combinational and sequential design
2. Construct and troubleshoot combination and sequential circuits
3. Use Boolean algebra to describe the logic of a combinational designed circuit
4. Describe De Morgans Laws and apply them to a logic circuit

Course Outline

A. Number Systems and Codes
    1. Digital versus Analog
    2. Digital Representations of Analog Quantities
    3. Decimal Numbering System (Base 10)
    4. Binary Numbering System (Base 2)
    5. Decimal-to-Binary Conversion
    6. Octal Numbering System (Base 8)
    7. Octal Conversions
    8. Hexadecimal Numbering Systems (Base 16)
    9. Hexadecimal Conversions
    10. Binary-Coded-Decimal System
    11. Comparison of Numbering Systems
    12. The ASCII Code

B. Digital Electronic Signals and Switches
    1. Digital Signals
    2. Clock Waveform Timing
    3. Serial Representation
    4. Parallel Representation
    5. Switches in Electronic Circuits
    6. A Relay as a Switch

C. Basic Logic Gates
    1. The AND Gate
    2. The OR Gate
    3. Timing Analysis
    4. Enable and Disable Functions
    5. Using IC Logic Gates
    6. Introduction to Troubleshooting Techniques
    7. The Inverter
    8. The NAND Gate
    9. The NOR Gate
    10. Logic Gate Waveform Generation
    11. Using IC Logic Gates

D. Boolean Algebra and Reduction Techniques
    1. Combinational Logic
    2. Boolean Algebra and Rules

3. Simplification of Combinational Logic Circuits Using Boolean Algebra
4. De Morgan's Theorem
5. The Universal Capability of NAND and NOR Gates
6. Karnaugh Mapping
7. System Design Applications

E. Exclusive-OR and Exclusive-NOR Gates
   1. The Exclusive-OR Gate
   2. The Exclusive-NOR Gate
   3. Parity Generator/Checker
   4. System Design Applications

F. Arithmetic Operations and Circuits
   1. Binary Arithmetic
   2. Two's-Compliment Representation
   3. Two'-Compliment Arithmetic
   4. BCD Arithmetic
   5. Arithmetic Circuits
   6. Four-Bit-Full Adder ICs
   7. System Design Applications

G. Code Converters, Multiplexers, and Demultiplexers
   1. Comparators
   2. Decoding
   3. Encoding
   4. Code Converters
   5. Multiplexers
   6. Demultiplexers

Grade Scale

90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
0 – 59	F

Course Requirements

1. Contrast analog and digital devices and techniques.
2. List devices that use digital techniques.
3. Describe the advantages of using digital techniques.
4. Discuss the characteristics and uses of binary, BCD, Gray, and ASCII codes.
5. Code into ASCII, or decode from ASCII, any sequence of characters from ASCII.
6. Describe the differences between using the electromechanical devices and transistors for data representation.
7. Explain the circumstances where data would be transmitted serially.
8. Draw the waveform of a specific serial word.
9. Explain the circumstances where data would be transmitted parallel.
10. Draw a switch register, a relay register, and a transistor register containing a specific parallel word, then connect it to a data bus.
11. Describe and illustrate positive logic.
12. Describe and illustrate negative logic.
13. Identify and count in each of the four number systems (binary, octal, decimal, hexadecimal).
14. Find the compliment of any number (in binary, octal, and hexadecimal).
15. Change any positive number to its equivalent negative number.
16. Change any negative number to its equivalent positive number.
17. Add and subtract in each number system (correctly showing the carry/borrow).
18. Explain the weights of each position in each number system.

19. List any number in BCD.
20. Add and subtract BCD numbers.
21. Identify and draw the standard symbols for inverters, AND, OR, NAND, and NOR gates.
22. List the truth tables for each logic function and/or give the logic function for each truth table.
23. Write or identify the Boolean equation for each logic function.
24. List the unique inputs and unique outputs for each gate.
25. Determine the input conditions to a simple gate combination circuit that would produce the unique output.
26. Select inverters for inputs and/or outputs to make any gate perform the function of any other gate.
27. Identify the level of the input that would inhibit each gate, then determine what the output would be.
28. Identify the level of the input that would enable each gate, then determine what the output would be.
29. Write boolean equations for gates and given combinations of gates.
30. Draw gate diagrams for simple and given complex boolean equations.
31. List the truth tables for each gate or given combination of gates.
32. Draw the gate diagrams for given truth tables.
33. Write the boolean equation for given truth tables.
34. List the truth tables for given boolean equations.
35. Use the boolean rules and DeMorgan's theorem to simplify given complex boolean equations.
36. Use the boolean rules and DeMorgans's theorem to simplify given complex logic circuits.
37. Simplify given complex logic circuits using Karnaugh maps.
38. Draw the logic diagram with pinouts for the 7486 and the 4070. Then write the X-OR truth table and boolean equation.
39. Draw the diagram of a four-bit parity generator/checker. (odd and even)
40. Draw the block diagram of a serial data communication system showing how parity generators and parity checkers operate within the system.
41. Explain the operation of binary to Gray and Gray to binary code converters.
42. Draw the diagram of and explain the operation of a four-bit comparator circuit.
43. Explain the operation of the 7485 four-bit magnitude comparator.
44. Draw the block diagram of half adder and full adder, labeling inputs and outputs, with the truth table.
45. Draw the block diagram of and explain an eight-bit serial adder.
46. Explain the operation of a four-bit serial adder.
47. Draw the block diagram of and explain an eight-bit parallel adder.
48. List example problems that can be used to verify the operation of a 7483 four-bit adder/subtracter Include positive inputs with and without a carry in, and with and without a carry out.
49. Draw a circuit diagram of a four-bit adder/subtracter which can be built in the Lab (use the 7486 as a controlled inverter, the 7483, and necessary circuitry).

50. Draw a 7447 BCD to 7-segment display decoder/driver properly connected to a common anode display.
51. Recall material on decoders in the text.
52. Draw decoding circuits that will decode specific hex numbers on a four-bit data bus, an eight-bit data bus, and a sixteen-bit data bus.
53. Draw a BCD decoder circuit containing a 7442 and predict the output under all input conditions. Then use 2-7442s to decode a four-bit hexadecimal number.
54. Draw a decoder circuit containing a 3-line to 8-line 74138 decoder and predict the output under all input conditions.
55. Draw a basic encoder circuit, using SSI gates, that will encode a three-bit bus (or a four-bit bus) when one of eight (or one of sixteen) inputs is made active.
56. Draw a 74148 8-line to 3-line priority encoder circuit and predict the output under all input conditions.
57. Draw a 74147 10-line to 4-line priority encoder circuit and predict the output under all input conditions.
58. Recall the material on multiplexers and demultiplexers in the text.
59. Locate the data on the multiplexers and demultiplexers contained in the required reference book.
60. Identify the characteristics, pin numbers, designations, and function tables of the multiplexers in the required reference book.
61. Draw a simple multiplexer circuit and explain its operation.
62. Draw a simple demultiplexer circuit and explain its operation.
63. Draw a circuit using a multiplexer circuit that will convert an eight-bit parallel word to an eight-bit serial word (LSB first).
64. Draw a circuit using a multiplexer that will generate a specified serial binary word.

Disabilities Statement

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http://www.lit.edu/depts/stuserv/special/defaults.aspx

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Course Schedule

Week	Topic	Reference
1/2	Course introduction and policies • Lecture • Lab: Multisim	Handouts
3/4	Number Systems and Codes/Digital Electronic Signals and Switches • Lecture • Lab: Multisim • Test One	Chapters 1/2
4/5/6	Basic Logic Gates • Lecture • Lab: Experiments • Project: As Assigned	Chapter 3
7	Boolean Algebra and Reduction Techniques • Lecture • Lab: Chapter Exercises • Project: As Assigned • Test Two	Chapter 5
8/9	Exclusive-OR and Exclusive-NOR Gates • Lecture • Lab: Experiments • Project: As Assigned	Chapter 6
10/11/12	Arithmetic Operations and Circuits • Lecture • Lab: Experiments • Project: As Assigned • Test Three	Chapter 7
13/14/15	Code Converters, Multiplexers, and Demultiplexers • Lecture • Lab: Experiments • Project: As Assigned	Chapter 8
16	Final Project • Lecture • Project: As Assigned • Test Four	