Semester 1 Final Study Guide

Digital Electronics

***Directions**: Complete all of the work in your engineering notebook. Completion of this review study guide will count like an engineering notebook check worth 30 points.*

Semester 1 Outline:

A. Scientific Notation vs. Engineering Notation
- Explain how to write numbers in scientific notation.
- Explain how to write numbers in engineering notation.
- What are the SI prefixes that you will need to memorize in order to write numbers in Scientific notation or engineering notation?

B. Component Identification: Resistors and Capacitors
- What is a resistor?
- How do you determine the nominal value for a resistor?
- What is a capacitor?
- How do you determine the nominal value for a capacitor?

C. Circuit Theory Laws:
- What is current, voltage, and resistance?
- What is Ohm's Law?
- What is the difference between Parallel Circuits and Series Circuits?

D. Analog vs. Digital Signals
- What is a logic level?
- What is an analog Signal?
- What is a digital Signal?

E. Number Systems
- Binary
  i. Why do engineers use the binary system to express numbers?
  ii. How do you convert from decimal→ binary and from binary→ decimal?
- Octal
  i. How do you convert from octal → Decimal and from decimal → octal?
- Hexadecimal
  i. How do you convert from hexadecimal → decimal and from decimal → hexadecimal?

F. Combinational Design Logic: AOI
- What is AOI Logic? What do each of the gates represent in AOI logic?
- How do you write a truth table if given 2 inputs, 3 inputs, etc.?
- How do you find minterms from a truth table?
- How do you write a logic expression from minterms or from a truth table?
- How do you draw circuits from logic expressions?
- How do you derive a truth table from an existing circuit using "method 1"?
- How do you derive a truth table from an existing circuit using "method 2"?

G. Alternative Combinational Design Logic:
   - NAND Logic
     i. What is NAND logic? What do each of the gates represent in NAND logic?
   - NOR Logic
     i. What is NOR logic? What do each of the gates represent in NOR logic?
   - What are the pros/cons of using NAND/NOR logic over AOI logic?

H. Circuit Simplification Techniques
   i. Boolean Algebra
      - Explain how to simplify logic expressions using Boolean Algebra.
   ii. DeMorgan's Theorems
      - Explain how to simplify logic expressions using DeMorgan's Theorems.
   iii. K-Mapping
      - Explain how to simplify logic expressions using the K-mapping technique.

I. Seven Segment Displays
   - What does each "segment" represent?
   - What is the different between a Common Anode and a common cathode?
   - Explain how you could display any number using a seven segment display.

Example Final Questions

1. Write the following numbers in engineering notation and scientific notation.
   a) 0.00033000
   b) 100300

2. Using the resistor color code chart determine the nominal resistance value for a resistor with the following colors:
   a) Violet/Black/Blue/Gold
   b) Gray/Yellow/Green/Silver

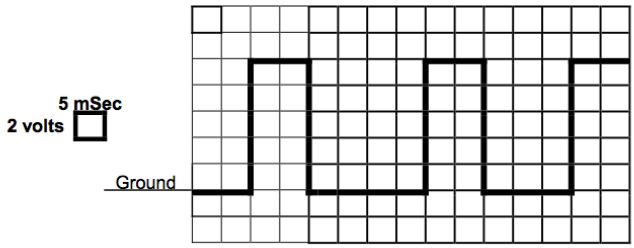
3. Use the following circuit to calculate each of the following: (make sure to include units!)

   a) Calculate the total resistance, total current, and the total voltage
   b) Calculate the current flowing through each component
   c) Calculate the voltage across each component
   d) Is this a parallel or series circuit?

4. Convert the following binary numbers into decimal.
   a) 101011_2
   b) 10_2
   c) 100_2
   d) 110011_2

5. Convert the following decimal numbers into binary
   a) 17_{10}
   b) 189_{10}
   c) 11_{10}
   d) 100_{10}

6. For the square wave shown below, determine its (a) period, (b) frequency, (c) duty cycle, and (d) amplitude. Be sure to show correct units.



(a) Period
(b) Frequency
(c) Duty Cycle
(d) Amplitude

7. Determine the minterms from the following truth table and then write the logic expression

X	Y	Z	F
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

8. Use the following truth table to answer the questions below

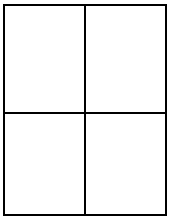
P	Q	R	F_3
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Write the Logic Expression from the Truth Table above.
a) Draw the circuit for the following Logic Expression that you wrote using AOI logic
b) Check to make sure that your circuit is correct using method 1 or method
c) Redraw the circuit using NAND logic and simplify
d) Redraw the circuit using NOR logic and simplify

9. Write the most simplified logic expression using the K-mapping technique

a)

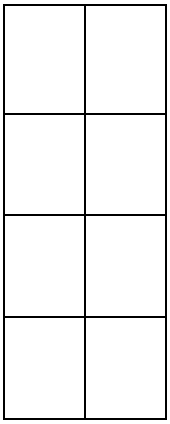
A	B	F_1
0	0	0
0	1	1
1	0	1
1	1	1



$F_1 =$ _____

b)

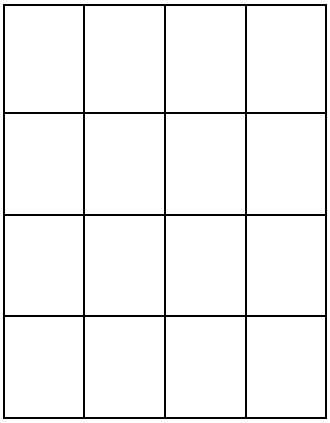
A	B	C	F_2
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1



$F_2 =$ _____

c)

A	B	C	D	F_3
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1



$F_3 =$ _____

10. Use the following expression to answer the questions below:

$$F_1 = A\,\overline{C} + \overline{A}\,C + A\,\overline{B}\,C$$

a) Draw the above circuit using the fewest possible gates using AOI logic.
b) Draw the above circuit using only 2 input gates using AOI logic.

11. Simplify the following logic expressions using Boolean and DeMorgan's Theorems

a)

$$F_4 = PS + P\overline{Q}\,\overline{S} + PQS$$

b)

$$F_2 = \overline{(\overline{X} + Z)(\overline{XY})}$$

12. Convert the following decimal numbers to octal and hexadecimal.
a) 10_{10}
b) 100_{10}
c) 3345_{10}

13. Convert the following octal numbers to decimal numbers.
a) 367_8
b) 100_8

14. Convert the following hexadecimal numbers to decimal numbers.
a) $2A3_{16}$
b) $1AB3_{16}$

15. From the following logic expression create the truth table.

$$F_1 = \overline{A}\,B\,\overline{C}\,D + B\,C\,\overline{D} + A\,\overline{B}$$

16. From the following circuit derive the logic expression using test points from "method 1" or "method 2".