

# 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

- #1
- 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

- #2
- 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:

- #3
- 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

- #6
- What is a logic level?
  - What is an analog Signal?
  - What is a digital Signal?

#### E. Number Systems

- #4,5
- Binary
    - i. Why do engineers use the binary system to express numbers?
    - ii. How do you convert from decimal → binary and from binary → decimal?
- #12,13
- Octal
    - i. How do you convert from octal → Decimal and from decimal → octal?
- #12,14
- 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?
- #15
- How do you write a truth table if given 2 inputs, 3 inputs, etc.?
- #7
- How do you find minterms from a truth table?
- #7,8
- How do you write a logic expression from minterms or from a truth table?
- #8,10
- How do you draw circuits from logic expressions?
  - How do you derive a truth table from an existing circuit using "method 1"?
- #16
- 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?

#8

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.

#11a

#11b

#9

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.

\*final project!

Example Final Questions

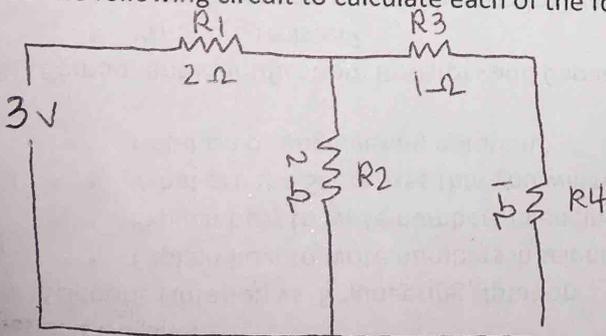
1. Write the following numbers in engineering notation and scientific notation.

- a) 0.00033000  $3.3000 \times 10^{-4}$  , 330M
- b) 100300  $1.003 \times 10^5$  ,  $100.3 \times 10^3$

2. Using the resistor color code chart determine the nominal resistance value for a resistor with the following colors:

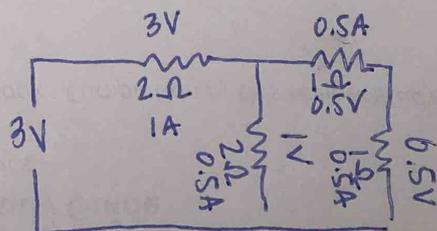
- a) Violet/Black/Blue/Gold  $70M \pm 5\%$
- b) Gray/Yellow/Green/Silver  $8400K \pm 10\%$

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



$R_T = 3\Omega$   $I_T = 1A$   $V_T = 3V$

- 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? **BOTH!**



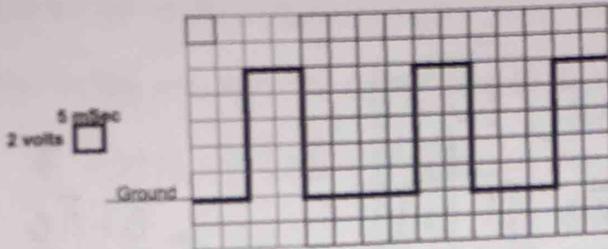
4. Convert the following binary numbers into decimal.

- a)  $101011_2 = 43_{10}$
- b)  $10_2 = 2_{10}$
- c)  $100_2 = 4_{10}$
- d)  $110011_2 = 5_{10}$

5. Convert the following decimal numbers into binary

- a)  $17_{10} = 10001_2$
- b)  $189_{10} = 10111101_2$
- c)  $11_{10} = 1011_2$
- d)  $100_{10} = 1100100_2$

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 = 30 mSec
- (b) Frequency = 0.033 mHz
- (c) Duty Cycle = 33.3%
- (d) Amplitude 10 V.

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

$$F = \bar{x}\bar{y}\bar{z} + \bar{x}\bar{y}z + x\bar{y}z + xy\bar{z} + xyz$$

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

P	Q	R	F <sub>3</sub>
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 2
- c) Redraw the circuit using NAND logic and simplify
- d) Redraw the circuit using NOR logic and simplify

\*see attached sheet!

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

a)

A	B	F <sub>1</sub>
0	0	0
0	1	1
1	0	1
1	1	1

	$\bar{B}$	B
$\bar{A}$	0	1
A	1	1

$$F_1 = A + B$$

b)

A	B	C	F <sub>2</sub>
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

	$\bar{C}$	C
$\bar{A}\bar{B}$	0	1
$\bar{A}B$	1	1
AB	1	1
A $\bar{B}$	0	0

$$F_2 = B + \bar{A}C$$

c)

A	B	C	D	F <sub>3</sub>
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

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	C $\bar{D}$
$\bar{A}\bar{B}$	0	1	0	1
$\bar{A}B$	0	1	1	1
AB	0	0	1	0
A $\bar{B}$	0	0	1	0

$$F_3 = \bar{A}\bar{C}D + \bar{A}C\bar{D} + BCD + ACD$$

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

$$F_1 = A\bar{C} + \bar{A}C + A\bar{B}C$$

- 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.
- ~~c) Draw the above circuit using NAND logic~~
- ~~d) Draw the above circuit using NOR logic~~

\* see attached \*

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

a)  $F_4 = PS + P\bar{Q}\bar{S} + PQS$       $F_4 = PS + P\bar{Q}$

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

12. Convert the following decimal numbers to octal and hexadecimal.

- a)  $10_{10} = 12_8, A_{16}$
- b)  $100_{10} = 144_8, 64_{16}$
- c)  $3345_{10} = 6421_8, D11_{16}$

13. Convert the following octal numbers to decimal numbers.

- a)  $367_8 = 247_{10}$
- b)  $100_8 = 64_{10}$

14. Convert the following hexadecimal numbers to <sup>decimal</sup> binary numbers.

- a)  $2A3_{16} = 675_{10}$
- b)  $1AB_{16} = 6035_{10}$

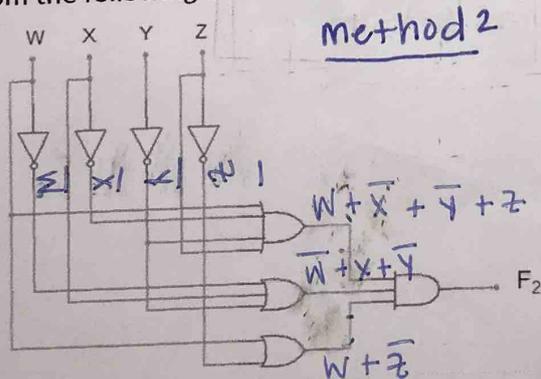
A	B	C	D	F <sub>1</sub>
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

\*  $\bar{A}BCD$   
 \*  $BC\bar{D}$   
 \* }  $A\bar{B}$   
 \* }  
 \*  $BC\bar{D}$

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

$$F_1 = \bar{A}B\bar{C}D + B\bar{C}\bar{D} + A\bar{B}$$

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



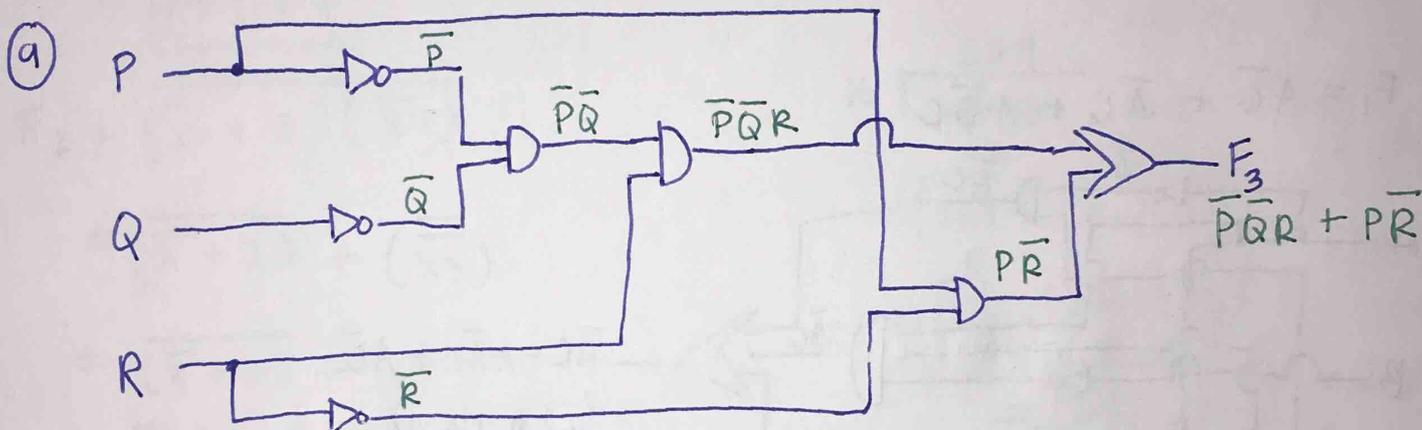
$$F_2 = (W + \bar{X} + \bar{Y} + Z)(\bar{W} + X + \bar{Y})(W + \bar{Z})$$

(8)

$$F_3 = \bar{P}\bar{Q}R + P\bar{Q}\bar{R} + PQ\bar{R} \text{ (unsimplified)}$$

	$\bar{R}$	$R$
$\bar{P}\bar{Q}$	0	1
$\bar{P}Q$	0	0
$P\bar{Q}$	1	0
$PQ$	1	0

$$F_3 = \bar{P}\bar{Q}R + P\bar{R}$$



(b) method 2 - see above.

(c) using NAND logic

