

USAF ACADEMY

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE 281 GRADED REVIEW #1 SPRING 2016

Name: _____

Section: _____

Academic Security This examination is not released from academic security until **1630 on 16 February 2016**. Until this time, you may not discuss the examination contents or the course material with anyone other than your instructor.

Integrity Your honor is extremely important. This academic security policy is designed to help you succeed in meeting academic requirements while practicing the honorable behavior our country rightfully demands of its military. Do not compromise your integrity by violating academic security or by taking unfair advantage of your classmates.

Authorized Resources Calculator

- Instructions**
- **Show all work for full credit**
 - Box or circle your final answer.
 - For all numerical answers, use engineering notation and include units.
 - Completely label all your diagrams, drawings, graphs, etc. for full credit.
 - You have **53 minutes** to complete this exam.
-

| Problem | Value | Earned |
|---------|-------|--------|
| 1 | 20 | |
| 2 | 20 | |
| 3 | 18 | |
| 4 | 16 | |
| 5 | 6 | |
| 6 | 20 | |
| Total | 100 | |

This page intentionally left blank.

ECE 281 – GR #1

Problem 1

Number Conversions

a. Using 2s complement representation, the range of numbers you can represent with eight bits is:

b. Convert 111101_2 to hexadecimal. Show your work.

- a. 75 b. 3D c. E1 d. 61 e. none of these

c. Convert 101_{10} to octal. Show your work.

- a. 131 b. 145 c. 65 d. 61 e. none of these

d. Convert 1010110_2 to decimal. Show your work.

- a. 108 b. 29 c. 56 d. 86 e. none of these

e. Convert 27_{16} to binary. Show your work.

- a. 011011 b. 101010 c. 100110 d. 010111 e. none of these

f. Convert -25_{10} to 6-bit 2s complement binary. Show your work.

- a. 100111 b. 111001 c. 011001 d. 010101 e. none of these

g. Convert -25_{10} to 6-bit signed magnitude. Show your work.

- a. 110101 b. 011001 c. 111101 d. 100111 e. none of these

Problem 2 (20 points)*Boolean Equations and Algebra*

a. Which expression is the most simplified form of $X + Y(Z + \overline{X} + \overline{Z})$?

- a. 0
- b. 1
- c. $X + Y$
- d. $X + YZ$
- e. $X + YZ + Y\overline{X}\overline{Z}$

b. Given that: $F(A, B, C) = \overline{A}BC + \overline{B}\overline{C} + BC$, what does $F(1, 1, 0)$ equal?

- i. 0
- ii. 1
- iii. C
- iv. \overline{C}
- v. none of these

c. Answer the following questions for this truth table.

| X | Y | Z | L |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

i. Write the Boolean equation for this truth table in SOP form.

L = _____

ii. Write the SOP in simplified form.

L = _____

d. Darth Vader will enjoy his picnic on sunny days that have no ants. He will also enjoy his picnic any day he sees a humming bird, as well as days where there are ladybugs but no ants. Write a Boolean equation for his enjoyment (E) in terms of sun (S), ants (A), hummingbirds (H), and ladybugs (L).

Problem 3*K Maps & Combinational Logic
Implementation*

a. Simplify the following equation using a Karnaugh map:

| A | B | C | D | Y |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | X |
| 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |

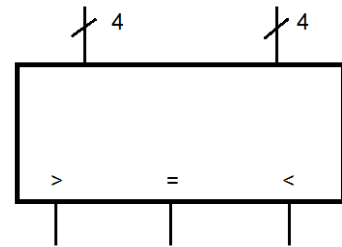
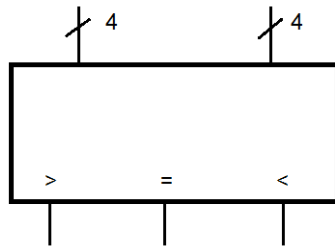
| | 00 | 01 | 11 | 10 |
|----|----|----|----|----|
| 00 | | | | |
| 01 | | | | |
| 11 | | | | |
| 10 | | | | |

Simplified Boolean Equation: $Y =$ _____

Problem 4

Circuit Design

- a. Given two four-bit magnitude comparators, add some combinational logic gates and create an eight-bit magnitude comparator. Ensure the inputs (and associated bits) are clearly labeled. The outputs are shown on the left side of the page. (**Hint: How would a person compare two numbers?**)



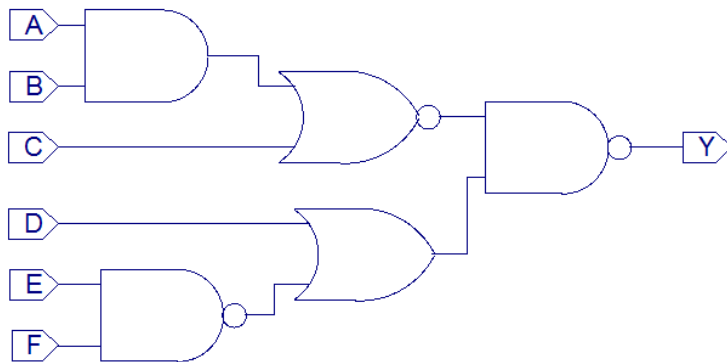
>

=

<

Problem 5*Timing Analysis*

Use the information in the below schematic and associated table to answer the next two questions.



| Gate | t_{pd} | t_{cd} |
|------|----------|----------|
| AND | 30 | 25 |
| OR | 30 | 25 |
| NAND | 20 | 15 |
| NOR | 40 | 20 |
| XOR | 60 | 40 |

- Draw the short path in the above schematic.
- Given the chart of gate delays in ps, calculate the length of the critical path. Show your work.