EECE 2322 – Embedded Design, Enabling Robotics

Homework #1

Assigned Wednesday, Sept. 4, 2024. Due: Monday, Sept. 16 by 11:59pm on Canvas

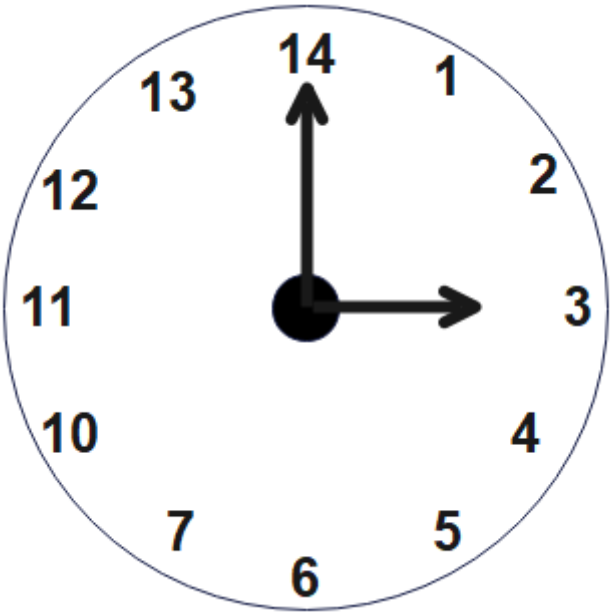
4 Problems, 100 points Total

Show your work!

Problem 1 (8 points)

The Mars rover Perseverance just discovered an ancient clock partially sticking out of the sand near its landing site – definitive proof that a technologically advanced civilization once existed on the Red Planet. Scientists have concluded that it is a 12-hour clock remarkably similar to clocks on Earth. The clock is shown in the figure below with the clock hands in the position corresponding to 3 o'clock on an Earth clock.

Question for you to answer: From the numbers on the clock determine how many fingers were on each hand of the ancient Martians. (Other evidence showed that they possessed two arms with hands at the ends of each arm).



The ancient Martians had four fingers on each hand. They use a base eight system which suggests that they have eight total fingers.

Problem 2 (32 points total, 8 points each)

Translate each pair of numbers into 8-bit two's complement binary numbers and add them. The sum will be an 8-bit two's complement number. Indicate:

i. Whether or not the answer is correct

ii. If a carry occurred

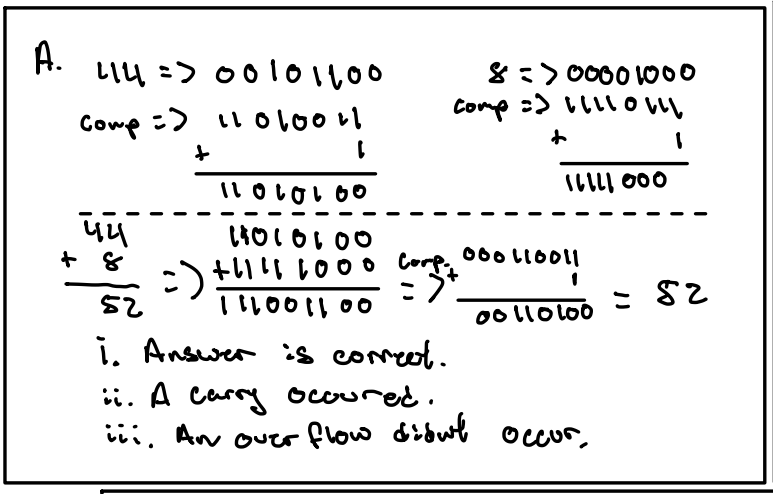
iii. If and overflow occurred

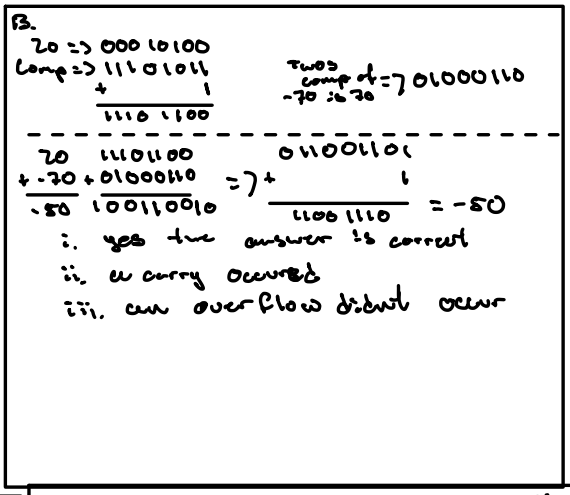
a. 44 + 8

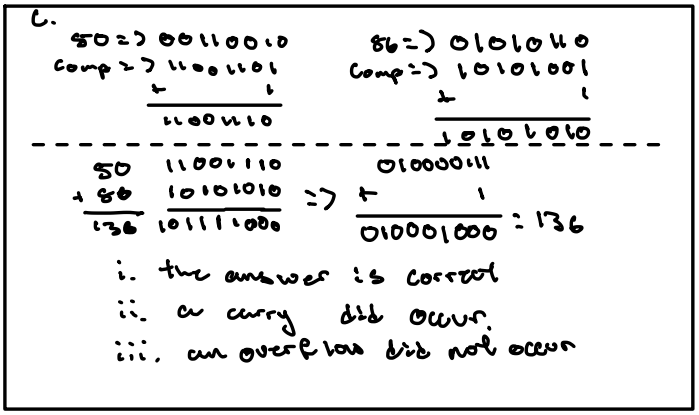
b. 20 + -70

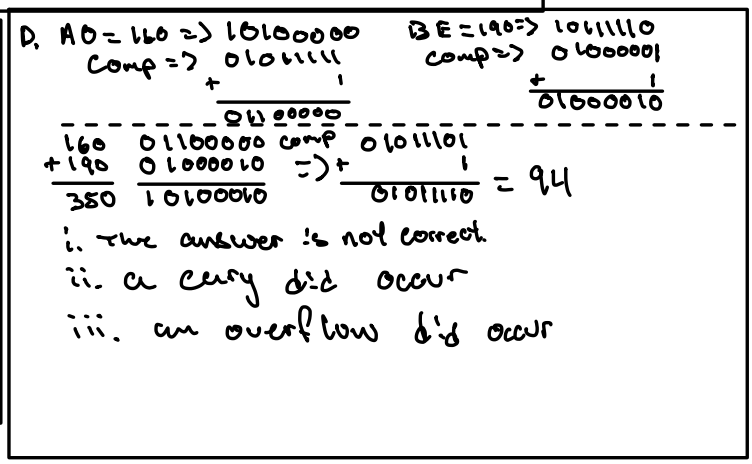
c. 50 + 86

d. 0xA0 + 0xBE









Problem 3 (30 points, 10 points each)

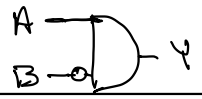
Simplify each of the following Boolean equations (4 points). State the theorem(s) and axiom(s) used for each step of the simplification (3 points). Sketch a combinational logic circuit from each simplified equation (3 points).

a. $Y = A\bar{B}C + A\bar{B}\bar{C}$

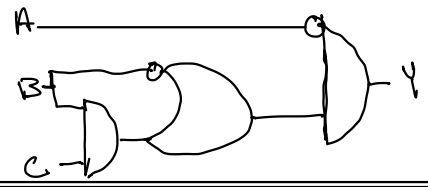
b. $Y = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}BC$

c. $Y = \overline{(AB)} + A + B + C$

A. $Y = A\bar{B}C + A\bar{B}\bar{C}$
$= A\bar{B}(C+\bar{C})$ Dist theorem
$= A\bar{B}(1)$ complements dual
$= A\bar{B}$ Identity Theorem



B. $Y = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}BC$
$= \bar{A}(\bar{B}\bar{C} + \bar{B}C + BC)$ Dist. Theorem
$= \bar{A}(\bar{B}(\bar{C}+C) + BC)$ Dist. Theorem
$= \bar{A}(\bar{B}(1) + BC)$ Comp. Dual
$= \bar{A}(\bar{B} + BC)$ Identity Theorem

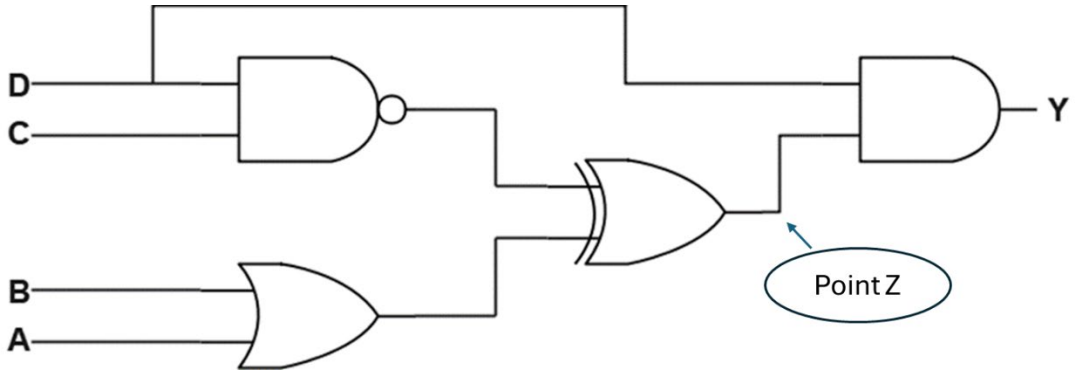


C. $Y = \overline{(AB)} + A + B + C$
$Y = \bar{A} + \bar{B} + A + B + C$ Bubble Pushing
$= 1 + 1 + C$ And/or Dual
$= 1$ Null Element Dual

1 — Y

Problem 4 (30 points)

What is the output **Y** and the logic state at point **Z** of this circuit for each of the given inputs (A, B, C, and D).



Inputs				Point	Output
A	**B**	**C**	**D**	**Z**	**Y**
0	0	0	0	1	0
0	1	1	1	1	1
0	0	1	0	1	0
1	0	1	1	1	1