MIDTERM_SPRING_2024

● Graded

Student

Total Points

97 / 100 pts

Question 1

(no title) **25** / 27 pts

1.1 **(no title)** **9** / 9 pts

✔ **+ 9 pts** Correct

1.2 **(no title)** **7** / 9 pts

✔ **+ 7 pts** Almost correct OR correct but used (r-1)'s complement algorithm

1.3 **(no title)** **9** / 9 pts

✔ **+ 9 pts** Correct

Question 2

(no title) **10** / 10 pts

✔ **+ 10 pts** Correct

Question 3

(no title) **18** / 18 pts

3.1 **(no title)** **9** / 9 pts

✔ **+ 9 pts** Correct

3.2 **(no title)** **9** / 9 pts

✔ **+ 9 pts** Correct

Question 4

(no title) **17** / 18 pts

4.1 **(no title)** **8** / 9 pts

✔ **+ 8 pts** Correct answer but can be simplified more

4.2 **(no title)** **9** / 9 pts

✔ **+ 9 pts** Correct answer with full work

Question 5

(no title) **27** / 27 pts

5.1 **(no title)** **9** / 9 pts

✔ **+ 9 pts** Correct (xy' + x'y)

5.2 **(no title)** **9** / 9 pts

✔ **+ 9 pts** Correct with correct answer for 5.1)

5.3 **(no title)** **9** / 9 pts

✔ **+ 9 pts** Correct

1.1) Convert the numbers $M = 87_{10}$ and $N = 43_{10}$ to base 2,

87	1
43	1
21	1
10	0
5	1
2	0
1	1
0	

$M = 1010111$

43	1
21	1
10	0
5	1
2	0
1	1
0	

$N = 101011$

02) then perform $M - N$ using the $r's$ complement representation subtraction algorithm.

$N_{1C} = 1010100$ → $M + N_{1C} = 1010111 + 1010100 = 10101011$

$01010101 + 1 = 10110100$

$M - N = 1011100$

3) Finally, convert the result to base 8.

101 100

5 4 → 54

2. Given the equality: $32_x = 27_8$, determine the value of the radix x.

$3x + 2 = 2 \cdot 8 + 7$

$3x + 2 = 16 + 7 = 23$

$3x = 21$ → $x = 7$

3.1) Is Boolean NOR operator, defined by: $x \downarrow y = (xy)'$ COMMUTATIVE? Give BA justification.

Prove: $x \downarrow y = y \downarrow x$

LHS

$x \downarrow y = (x + y)'$

$\overset{10}{=} x'y'$

$(xy)'$

RHS

$y \downarrow x = (y + x)'$

$\overset{10}{=} y'x'$

$\overset{3}{=} x'y'$

LHS = RHS

∴ NOR is commutative

2) Is it ASSOCIATIVE? Give BA (boolean algebra) justification.

Prove: $\exists x, y, z$ s.t. $(x \downarrow y) \downarrow z \neq x \downarrow (y \downarrow z)$

$x = 0, y = 0, z = 0$

LHS

$(0 \downarrow 0) \downarrow 1$

$1 \downarrow 1$

0

RHS

$0 \downarrow (0 \downarrow 1)$

$0 \downarrow 0$

1

LHS ≠ RHS → NOR is not associative. Proved by counterexample

1) $f = ((x + y') * (x' + y + z') * (x + z))'$

$\overset{10}{=} x'y + xy'z + xz'$ DeMorgan's Identity

$\overset{2,5}{=} x'yz + x'yz' + xy'z + xy'z' + xy'z'$

$\overset{4}{=} x'y(z+z') + xy'z + x'z'(y+y')$ expansion

$\overset{2,5}{=} x'y + xy'z + xz'$ contraction leads to same result

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2) $f = (AC + (B + C)' + (AC)'B')'$

$\overset{10}{=} (A'+C')(B+C)''(AC)'' + B)$

$\overset{9}{=} (A'+C')(B+C)((AC)+B)$

$\overset{4}{=} (A'+C')(B+C)(B+C)(B+A)$

$\overset{7}{=} (A'+C')(B+C)(B+A)$

$\overset{11}{=} (A'+C')(B+AC)$

$\overset{4}{=} A'B + A'AC + C'B + C'CA$

$\overset{5}{=} A'B + (0)C + C'B + (C)A$

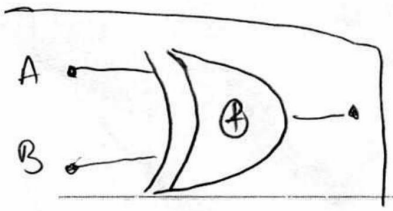
$\overset{2}{=} A'B + C'B$

$A'B + C'B$

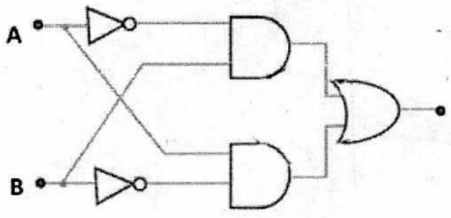
5.1) Represent the following circuit as a boolean function $f(A, B)$, and simplify it: 2.

$f(A,B) = A'B + B'A$

$f(A,B) = A \oplus B$



A	B	A'	B'	A'B	B'A	A'B+B'A
1	1	0	0	0	0	0
1	0	0	1	0	1	1
0	1	1	0	1	0	1
0	0	1	1	0	0	0



2) Draw the truth table for boolean function $f()$.

same truth table as $A \oplus B$

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3) What is another name for the operation that $f()$ computes? Spell the two-, three-, or four-letter word from left to right in the boxes below:

X	O	R