INDIVIDUAL ASSIGNMENT

Number System, Digital Logic and Boolean Algebra

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LECTURER

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QUESTION 1: BINARY SUBTRACTION AND 2'S COMPLEMENT CONCEPT

a) Explain why 2's complement is essential in binary subtraction involving signed numbers. Provide an example using 4-bit binary numbers to illustrate subtraction of a larger number from a smaller one.

For example: A = 0100_2 and B = 1011_2, what happens If you try to subtract 1101_2 from 0101_2 using basic binary subtraction rules, what problem will they face? Demonstrate the solution using 2's complement.

QUESTION 2: LOGIC GATE IMPLEMENTATION USING UNIVERSAL GATES

a) Design an AND gate using only NAND gates. Show your implementation with a truth table and circuit diagram.

b) Design an OR gate using only NAND gates. Show your implementation with a truth table and circuit diagram.

c) Design a NOT gate using only NAND gate. Show your implementation with a truth table and circuit diagram.

d) 4) Design an AND gate using only NOR gates. Show your implementation with a truth table and circuit diagram.

e) 5) Design an OR gate using only NOR gates. Show your implementation with a truth table and circuit diagram.

f) Design a NOT gate using only NOR gate. Show your implementation with a truth table and circuit diagram.

N.B.

- Don't forget to test your implemented circuits using the **Logic.ly Simulator (visit this link to use this simulator https://logic.ly/demo/)**
- For guidance, Lecturer have shared a demo own video on how to use this simulator: **https://youtu.be/Wge0APXzkqE**

- Please take a **screenshot** of your tested circuit and **attach it to your assignment report**.

QUESTION 3: BOOLEAN ALGEBRA – SIMPLIFYING EXPRESSIONS

A revision video on Boolean Algebra, recorded by the lecturer, has been provided to support your learning. Watch here: https://youtu.be/j_oZOlOV_tg

a) $AB + A\overline{B} + \overline{A}B$

b) $(A + B)(A + \overline{B})(\overline{A} + B)$

c) $\overline{A + BC} + A\overline{B}$

d) $AB + A\overline{B} + \overline{A}B + \overline{A}\,\overline{B}$

e) $\overline{\overline{(A + \overline{B})} + \overline{(\overline{C} \cdot D)}}$

f) $\overline{\overline{A + B} \cdot \overline{\overline{C} + D}}$

g) $\overline{\left(\overline{A \cdot (\overline{B} + C)} + \overline{\overline{D} + E}\right)}$

h) $\overline{\overline{(\overline{A} + B) \cdot (C + \overline{D})} + \overline{E}}$

ASSIGNMENT REPORT GUIDELINES – HYBRID FORMAT

a. **Handwritten Work**
   i. Neatly solve all Number System and Boolean Algebra questions on paper.
b. **Digital Circuit Designs**
   i. Use the Logicly Simulator https://logic.ly/demo/ to design the required logic gates.
   ii. Take clear screenshots of your circuit diagrams.
   iii. Paste the screenshots into a Word document, then print and include it with your hard copy submission.

Note: Please compile all pages into a single, well-organized report and ensure they are neatly stapled together in the correct order before submission.

SUBMISSION DEADLINE

- 10th July 2025

====== Good Luck ======