Assignment-M3

Digital Logic Design

Digital System Design:

Adder-Subtractor:

1. **Derive** the **truth-table** and corresponding **output expressions (POS)** of **Sum (S)** and **Carry (C_{out})** of a **Half-Adder** having **inputs A** and **B. For the derived expression, design the combinational logic circuit** using **basic logic gates**.
    a. Use the above logic circuit to redesign the **Half-Adder** using only NAND gates.
    b. Use the above logic circuit to redesign the **Half-Adder** using only NOR gates.
2. **Derive** the **truth-table** and corresponding **output expressions (POS)** of **Sum (S)** and **Carry$_{out}$,(C_{out})** of a **Full-Adder** having **inputs A**, **B** and previous input stage carry**, Carry$_{in}$, (C_{in}). For the derived expression, design the combinational logic circuit** using **basic logic gates**.
3. **Derive** the **truth-table** and corresponding **output expressions (POS)** of **Difference (D)** and **Borrow (B)** of a **Half-Subtractor** having **inputs A** and **B. For the derived expression, design the combinational logic circuit** using **basic logic gates**.
    a. Use the above logic circuit to redesign the **Half-Subtractor** using only NAND gates.
    b. Use the above logic circuit to redesign the **Half-Subtractor** using only NOR gates.
4. **Derive** the **truth-table** and corresponding **output expressions (POS)** of **Difference, (D)** and **Borrow**,**(B_{out})** of a **Full-Subtractor** having inputs **A**, **B** and previous **input stage Borrow,(Z_{in}). For the derived expression, design the combinational logic circuit** using **basic logic gates**.
5. **Design** a **Full Adder** using **Half Adder Blocks.**
6. **Design** a **3 Bit Parallel Adder** using **Full Adder Blocks.**

Magnitude Comparators:

1. Design a **1 bit Magnitude Comparator**. State **how many input** and **output terminals** your device will have with **proper markings in a block diagram**. **For your design show** the **truth table, derive SOP output expressions** and **draw combinational logic diagram**.
2. Design a **2 bit Magnitude Comparator**. State **how many input** and **output terminals** your device will have with **proper markings in a block diagram**. **For your design show** the **logic expressions that you have used to connect the 1 bit magnitude comparator blocks** and **draw combinational logic diagram**.
3. Design a **3 bit Magnitude Comparator using 1 bit Magnitude comparator blocks**. State **how many input** and **output terminals** your device will have with **proper markings in a block diagram**. **For your design show** the **logic expressions that you have used to connect the 1 bit magnitude comparator blocks to create your 3 bit block diagram**.
4. Design a **4 bit Magnitude Comparator using 1 bit Magnitude comparator blocks**. State **how many input** and **output terminals** your device will have with **proper markings in a block diagram**. **For your design show** the **logic expressions that you have used to connect the 1 bit magnitude comparator blocks to create your 4 bit block diagram**.

Complex Digital System Design:

a) You are hired to design a system that can be used in a safety push button lock device. There will be three buttons for example A, B and C. If odd number of inputs are pressed, the lock mechanism opens. In any other case the lock mechanism remains closed. If any of two buttons is pressed simultaneously, an alarm sounds. Let's say X is the lock mechanism and Y is the alarm that makes the sound,
    i) construct a truth-table for the system and
    ii) find the minimized output expression using Boolean algebra or k-map
    iii) draw the logic diagram for the system.

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b) In a departmental store hired you to design a cash register, operated by four personnel- the store manager (A), the assistant manager (B), the cashier (C) and the chief accountant (D). At least two of these personnel must be present, along with the cashier, for the register to unlock. Design a logic system that can perform this operation. For your design, show the truth-table, write the simplified output expression and a draw logic diagram.
   i. construct a truth-table for the system and
   ii. find the minimized output expression using Boolean algebra or k-map
   iii. draw the logic diagram for the system

c) You are hired to design a fire alarm system for a duplex house. The fire sensors are A in ground floor and B in the top floor. The Alarm is Y. The fire alarm turns on if fire is detected either on the first or second floor or both floors together.
   i. Construct a truth-table for the system
   ii. Find the minimized output expression using Boolean algebra or k-map
   iii. Draw the logic diagram for the system
   iv. Draw the system using universal NAND Gates

Number System:

1. **Convert** the following.
   A. $(1001.1101)_2 = (???)_{10}$
   B. $(0.653)_{10} = (???)_2$
   C. $(125.5679)_{10} = (???)2$
   D. $(362.255)_{10} = (???)_8$
   E. $(10110.0011001)_2 = (???)_8$
   F. $(2365.4569)_{10} = (???)_{16}$
   G. $(10010.111001)_2 = (???)_{16}$
   H. $(10010011+01101100)_{BCD} = (???)_{10}$
   I. $(51)_{10} = (???)_{BCD}$
2. **Perform** the following **arithmetic operation** for each of the following **binary number**. Also **show for each of them** that **their decimal equivalent arithmetic operations provide similar result**.
   a) 10001X0110
   b) 10011+11100
3. **Convert** the **following** from **binary to gray**: (**show the conversion process in detail**)

a. 10110011	b. 101011111
c. 010010	d. 0101

4. **Convert** the **following** from **gray to binary**: (**show the conversion process in detail**)

e. 00110	f. 11001
g. 1001	h. 1100101
i. 0010100	j. 101101

5. **Assuming 8-bit number**, find the decimal number in
   a) Sign magnitude, b) **1's complement** and **c) 2's complement**
   For the following numbers:
   1. -23
   2. -52
   3. -38
   4. 44
   5. -63
   6. +31

6. Perform BCD(Binary Coded Decimal) addition of Decimal Numbers
   a. 12 and 16
   b. 5 and 12
   c. 13 and 6
   d. 8 and 11

Do not copy from your peers. If you do not understand anything, consult with them or me. Assignments copied will be considered obsolete. Assignment is due on the day you sit for your quiz-3. Keep a copy of your assignment with you for further consultation.