

Jordan University of Science and Technology
Computer Engineering Department
CPE 552-Computer Design-HW1
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Problem 1. On representation of positive and signed integers.

- (a) Determine the radix-16 representation of the integer whose radix-2 representation is: 1011010101000101.
- (b) Determine the radix-2 representation of the integer whose radix-10 (decimal) representation is $(7456)_{10}$.
- (c) represent the number $x = (-35)_{10}$ in two's complement and one's complement using 7-bit vectors.

Problem 2.

Provide the switching function table for a 2-bit adder. The high-level specification for the adder is:

Input: $x, y \in \{0, 1, 2, 3\}, c_{in} \in \{0, 1\}$

Output: $z \in \{0, 1, 2, 3\}, c_{out} \in \{0, 1\}$

Function: $z = (x + y + c_{in}) \bmod 4$ and

$$c_{out} = \begin{cases} 0 & \text{if } x + y + c_{in} < 4 \\ 1 & \text{otherwise} \end{cases}$$

Consider that the inputs (x and y) and output (z) are encoded in binary.

Problem 3. Using the postulates and theorems of Boolean algebra prove each of the following relations:

- (a) $a \oplus (a \oplus b) = b$, recall that $a \oplus b = ab' + a'b$
- (b) $(a' + b)(a + b') = (a \oplus b)'$
- (c) $abc' + bc'd + a'bd = abc' + a'bd$

Problem 4. Determine the switching functions represented by the following SEs (show the switching function table - truth table):

- (a) $E(x, y, z) = (x + y)(x' + y' + z)(x' + y + z)(y' + z')$
- (b) $F(x, y, z) = xyz + x'y + xyz' + xy'$

Problem 5. Determine the sum of minterms and the product of maxterms that are equivalent to:

$$E(x, y, z) = x' + x(x'y + y'z)'$$

Show the solution using variables first and then provide the compact notation ($\sum m$ and $\prod M$).

Problem 6. Design a combinational system that has four inputs a, b, c, d , and one output y . The output y is 1 if and only if the number represented by the binary vector (a, b, c, d) is prime (1 is not a prime number). Use Kmaps to obtain minimal expressions for y in both SP and PS form. Implement this system with minimal two-level networks for both AND-OR and OR-AND net types.