ECE 124 digital circuits and systems
Assignment #1

Q1: Use algebraic manipulation to show that:

(a) $(x + y)(x + y') = x$

(b) $xy + yz + x'z = xy + x'z$

Q2: Use algebraic manipulation to simply the following Boolean expressions as much as possible:

(a) $(x'y' + z)' + z + xy + wz$ (**Hint:** This expression simplifies to 3 literals).

(b) $A'B(D' + C'D) + B(A + A'CD)$ (**Hint:** This expression simplifies to 1 literal).

Q3: Determine the truth tables for each of the following functions:

(a) $(xy + z)(y + xz)$

(b) $(A' + B)(B' + C)$

(c) $y'z + wxy' + wxz' + w'x'z$

Q4: Draw logic diagrams for each of the following Boolean expressions:

(a) $Y = A'B' + B(A + C)$

(b) $Y = A' + CD$

(c) $Y = (A + B')(C' + D)(A' + B + D)$

Q5: Use algebraic manipulation to find the minimum product-of-sums (POS) expressions for the following functions:

(a) $f = (x_1 + x_3 + x_4)(x_1 + x_2^{'} + x_3)(x_1 + x_2^{'} + x_3^{'} + x_4)$

(b) $f = x_2 + x_1x_3 + x_1^{'}x_3^{'}$

Q6: Use algebraic manipulation to find the minimum sum-of-products (SOP) expressions for the following functions:

(a) $f = x_1x_2^{'}x_3^{'} + x_1x_2x_4 + x_1x_2^{'}x_3x_4^{'}$

(b) $f = x_1^{'}x_2^{'}x_3 + x_1x_3 + x_2x_3 + x_1x_2x_3^{'}$

Q7: Determine the simplest sum-of-products circuit that implements the function $f(x_1, x_2, x_3) = \sum m(1, 3, 4, 6, 7)$.

Q8: Determine the simplest product-of-sums circuit that implements the function $f(x_1, x_2, x_3) = \Pi M(0, 2, 5)$.

Q9: Convert each of the following Boolean expressions into both sum-of-products and product-of-sums:

(a) $(AB + C)(B + C'D)$

(b) $x' + x(x + y')(y + z')$

Q10: Express $f(x_1, x_2, x_3, x_4) = x_2^{'}x_4 + x_1^{'}x_4 + x_2x_4$ as both a sum-of-minterms and as a product-of-maxtems.