

P1. (10 points) Using Venn diagram, prove the following:

- a) $(A + B)' = A' B'$
- b) $(A B)' = A' + B'$
- c) $x (y+z) = x y + x z$

P2. (10 points) Prove the following using Boolean algebra:

- a) $(A + C)(A B + A B') + AC + C = A + C$
- b) $A' (A + B) + (B + A A)(A + B') = A + A' B$

P3. (10 points) Use truth table to check the validity of the following:

- a) $A+(BC)=(A+B)(A+C)$
- b) $(A+B'C)=A' (B+C')$

P4. (10 points) Draw the logic circuits for the following expressions:

- a) $(A + B)C$
- b) $A + BC + D'$
- c) $AB + (AC)'$

P5. (20 points) Consider the logic function :

$$F(A, B, C, D) = (A+B)' (C+D) C'$$

- a) (4 points) Draw the logic circuit for the function above
- b) (4 points) Let the cost of a logic circuit be the total number of gates plus the total number of inputs to all gates in the circuit. (See pages 49, 50 in the book) What is the cost of above circuit?
- c) (4 points) Simplify the above function using Boolean algebra as much as possible.
- d) (4 points) Draw the logic circuit for the simplified version.
- e) (4 points) What is the cost of the simplified circuit?

P6. (10 points) The following truth table defines the logic function F(A,B,C).

- (a) Write the Boolean expression for F(A,B,C). Do not simplify.
- (b) Write the Boolean expression for F'(A,B,C). Do not simplify.

A	B	C	F(A,B,C)
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

P7. (10 points) Use DeMorgan's Laws to determine the complement (i.e. $F'(A,B,C,D)$) of the following Boolean expression:

$$F(A,B,C,D) = (A + B'C + A'D) (AC' + (BD)')$$

P8. (10 points) Construct a truth table for each of the following Boolean expressions:

(a) $F(A,B,C) = (A' + B) (B' + C) (A + B + C)$

(b) $F(A,B,C,D) = B'CD + AD' + A'BD + AB'C'D$

P9. (10 points) Find the minimum Sum of Products (SOP) expression for each of the following:

(a) $F(A,B,C,D) = \Sigma m(0, 2, 3, 4, 7, 8, 14)$

(b) $F(A,B,C,D) = \Pi M(1, 2, 3, 4, 9, 15)$

(c) Find the minimum Product of Sums (POS) expression for each of the functions given in (a) and (b).