1. Use Boolean theorems to prove the following identities:
   (a) $(A+C)(A+D)(B+C)(B+D) \;=\; A\cdot B+C\cdot D$
   (b) $(A+B)(\overline{A}+C)+B\cdot C \;=\; A\cdot C+\overline{A}\cdot B$
2. Use the laws and theorems of Boolean algebra to simplify the following expressions:
   (a) $\overline{A}\,B\,\overline{C}+\overline{A}\,B\,C+A\,\overline{B}\,\overline{C}+A\,\overline{B}\,C$
   (b) $\overline{A}\,\overline{B}\,\overline{C}\,\overline{D}+\overline{A}\,\overline{B}\,\overline{C}\,D+\overline{A}\,\overline{B}\,C\,\overline{D}+\overline{A}\,\overline{B}\,C\,D+A\,\overline{B}\,\overline{C}\,\overline{D}+A\,\overline{B}\,C\,\overline{D}$

3.1 Given

$$f(A,B,C) \;=\; \sum m_i(1,5,6,7)$$

(a) Prepare its truth table.
(b) Express f in a canonical sum of products form.
(c) Use Boolean logic to minimize f in a sum of products form.
(d) Sketch the two-level circuit for f obtained in part (c).
Assume literal complements are available.

3.2. Given

$$f(A,B,C) \;=\; \prod M_i(0,1,2,4,5,6)$$

(a) Prepare its truth table.
(b) Express f in a canonical product of sums form.
(c) Use Boolean logic to minimize f in a product of sums form.
(d) Sketch the two-level circuit for f obtained in part (c).
Assume literal complements are available.

4.1 Map the following functions and find the minimal sum of products form:

(a) $\overline{A}\cdot C \;+\; A\cdot\overline{B}\cdot C \;+\; A\cdot B \;+\; \overline{A}\cdot B\cdot\overline{C}$

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

4.2. Use the K-map method to find the minimized product of sums expressions for the following Boolean functions:

(a) $f(A,B,C) \;=\; (A\odot B)\cdot C$

(b) $f(A,B,C,D) \;=\; \sum m_i(1,2,4,5,10,14) \;+\; \sum d_i(0,6,13,15)$

where $\sum d_i(\ldots)$ means the sum of minterms that correspond to *don't care* outputs.

5. Draw schematics for the following expressions mapped into
   (a) NAND-only networks,
   (b) NOR-only networks.

   Assume that literals and their complements are available.

   i) $\overline{A}\cdot B \;+\; A \;+\; \overline{C} \;+\; \overline{D}$
   ii) $(A+B)\cdot(\overline{B}\cdot C)\cdot(\overline{A}+\overline{C})$
   iii) $(A\cdot B+C)\cdot E+D\cdot G$
   iv) $A\cdot\overline{B}\cdot(\overline{B}+C)\cdot\overline{D}+\overline{A}$