

**The University of Alabama in Huntsville**  
**Electrical & Computer Engineering**  
**CPE/EE 422/522**  
**Spring 2004**  
**Homework #1**

**Due January 27, 2003**

1. (20 points) Prove the identity of each of the following Boolean equations using algebraic manipulation.
  - a.  $\overline{X}\overline{Y} + X\overline{Y} + \overline{X}Y = \overline{X} + Y$
  - b.  $\overline{X}Y + X\overline{Y} + XY + \overline{X}\overline{Y} = 1$
  - c.  $\overline{X} + XY + X\overline{Z} + X\overline{Y}\overline{Z} = \overline{X} + Y + \overline{Z}$
  - d.  $X\overline{Y} + \overline{Y}\overline{Z} + \overline{X}\overline{Z} = X\overline{Y} + \overline{X}\overline{Z}$
2. (15 points) Obtain the truth table of the following functions and express each function in sum of minterms and product of maxterms.
  - a.  $(XY + Z)(\overline{Y} + XZ)$
  - b.  $(\overline{A} + B)(\overline{B} + C)$
  - c.  $\overline{Y}Z + WX\overline{Y} + WX\overline{Z} + \overline{W}\overline{X}Z$
3. (20 points) Simplify the following expressions by means of a four-variable map.
  - a.  $\overline{A}D + \overline{B}D + \overline{B}C + A\overline{B}D$
  - b.  $\overline{X}Z + \overline{W}X\overline{Y} + W(\overline{X}Y + X\overline{Y})$
  - c.  $\overline{A}BC + \overline{B}C\overline{D} + BCD + AC\overline{D} + \overline{A}\overline{B}C + \overline{A}B\overline{C}D$
  - d.  $\overline{A}BC + \overline{C}D + B\overline{C}D + \overline{B}C$
4. (10 points) Implement the following expression with two-input NAND gates.  
 $(AB + \overline{A}\overline{B})(\overline{C}\overline{D} + \overline{C}D)$
5. (15 points) Design a combinational circuit whose input is a four-bit number and whose output is the 2's complement of the input number.
6. (10 points) Construct a 5-to-32-line decoder with four 3-to-8 decodes with enable input and one 2-to-4-line decoder.
7. (10 points) Construct a 7-to-1 line multiplexer with as many 2-to-1 line multiplexers as are needed.