

**The University of Alabama in Huntsville**  
**Electrical & Computer Engineering**  
**CPE/EE 422/522 01**  
**Homework #1**  
**Spring 2005**

**Due January 27, 2005**

1. (10 points) Prove that the following identities are valid using algebraic manipulation.
  - a.  $ab' + bc' + ca' = a'b + b'c + c'a$
  - b.  $ab + a'c + bcd = ab + a'c$
  
2. (10 points) Find the complements of the following functions.
  - a.  $f = a + bc$
  - b.  $f = ab + b'c + ca'd$
  
3. (15 points) Obtain the truth table of the following functions and express each function in sum of minterms and product of maxterms.
  - a.  $xyz + xy'z'$
  - b.  $abc + ab'c' + a'b'c'$
  - c.  $\overline{YZ} + WX\overline{Y} + WX\overline{Z} + \overline{W}\overline{XZ}$
  
4. (20 points) Simplify the following expressions by means of a four-variable map.
  - a.  $\overline{AD} + \overline{BD} + \overline{BC} + \overline{ABD}$
  - b.  $\overline{XZ} + \overline{W}XY + W(\overline{XY} + X\overline{Y})$
  - c.  $\overline{ABC} + \overline{BCD} + \overline{BCD} + \overline{ACD} + \overline{ABC} + \overline{ABCD}$
  - d.  $ABC + CD + \overline{BCD} + \overline{BC}$
  
5. (10 points) Implement the following expression with two-input NOR gates.  
 $(AB + \overline{AB})(\overline{CD} + \overline{CD})$
  
6. (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.
  
7. (10 points) Construct a 5-to-32-line decoder with two 4-to-16 decodes with enable input and one 1-to-2-line decoder.
  
8. (10 points) Construct a 5-to-1 line multiplexer with as many 2-to-1 line multiplexers as are needed.