King Fahd University of Petroleum and Minerals
College of Computer Sciences and Engineering
Department of Computer Engineering

COE 202 – Digital Logic Design (T131)

<u>Homework # 02</u> (*due date & time: Tuesday 24/09/2013 during class period*)

> ***** Show all your work. No credit will be given if work is not shown! *****

<u>Showing all calculations steps</u> (i.e. final answers alone are not acceptable), solve the following problems:

Problem 1 (20 points): Prove the identity of each of the following Boolean equations, using algebraic manipulation:

   (a) $\overline{X}\overline{Y} + \overline{X}Y + XY = \overline{X} + Y$

   (b) $\overline{A}B + \overline{B}\overline{C} + AB + \overline{B}C = 1$

   (c) $Y + \overline{X}Z + X\overline{Y} = X + Y + Z$

   (d) $\overline{X}Y + \overline{Y}Z + XZ + XY + YZ = \overline{X}Y + XZ + Y\overline{Z}$

Problem 2 (20 points): Reduce the following Boolean expressions to indicated number of literals:

   (a) $\overline{X}\overline{Y} + XYZ + \overline{X}Y$ to three literals

   (b) $X + Y(Z + \overline{X + Z})$ to two literals

   (c) $\overline{W}X(\overline{Z} + \overline{Y}Z) + X(W + \overline{W}YZ)$ to one literal

   (d) $(AB + \overline{A}\overline{B})(\overline{C}\overline{D} + CD) + \overline{AC}$ to four literals

Problem 3 (10 points): Using DeMorgan's theorem, express the function

$$F = \overline{A}BC + A\overline{C} + \overline{A}B$$

   (a) with only OR and complement operations.
   (b) with only AND and complement operations.

Problem 4 (20 points): Find the complement of the following expressions:

   (a) $\overline{A}B + AB$ (complement should have 1 literal)

   (b) $(\overline{X} + \overline{Y})Z$ (complement should have 3 literals)

   (c) $W + (Y + \overline{Z} + YZ) + \overline{W}X + (\overline{Y} + Z)(Y + \overline{Z})$ (complement should have 4 literals)

   (d) $(A + B + \overline{C})(\overline{A}B + C)(A + B\overline{C})$ (complement should have 5 literals)

Problem 5 (30 points): Draw the logic diagram for the following Boolean expressions. The diagram should correspond exactly to the equation. Assume that the complements of the inputs are not available:

   (a) $XY\overline{Z} + X\overline{Y} + \overline{X}Z$

   (b) $X + \overline{X}(\overline{X} + Y) + (\overline{Y} + Z)$

   (c) $(\overline{A} + BC + C\overline{D})(\overline{B} + \overline{EF})$