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

COE 202 – Fundamentals of Computer Engineering (T101)

Homework # 04 (*due date & time: Sunday 19/12/2010 during class period*)

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

Problem # 1 (50 points): As a ***design engineer*** your manager asks you to design a circuit that will be used in a petrochemical plant. Using sensors S_1, S_2, S_3, and S_4 that are connected to the plant's petrochemical reservoir, the circuit monitors the reservoir's temperature, pressure, sulfur contents, and acidity, respectively. Every sensor produces a binary "1" if the phenomenon it monitors exceeds a predetermined threshold; otherwise the sensor produces a binary "0". The circuit receives the readings from each of the four sensors. Furthermore, the circuit controls 2 green light bulbs, L_1 and L_2. The circuit should behave as follows:

- Both L_1 and L_2 will be turned **on** (i.e. binary "1") if the circuit detects that **none** of the phenomena exceeded their corresponding thresholds.
- L_1 will be turned **off** (i.e. binary "0") if the circuit detects that the temperature, the pressure, or both exceeded the corresponding threshold.
- L_2 will be turned **off** (i.e. binary "0") if the circuit detects that the sulfur contents, the acidity, or both exceeded the corresponding threshold.

Design the circuit using all **NOR** gates.

Problem # 2 (10 points): Use a 4×16 **non-inverted-output decoder** and external gate(s) to implement the following function:

$$F_{A,B,C,D} = \sum(1,3,6,7,8,10,14)$$

Problem # 3 (10 points): Repeat problem # 2 but use a **4×16 inverted-output decoder** and external gate(s).

Problem # 4 (10 points): Repeat problem # 2 but use a **16×1 MUX** and external gate(s).

Problem # 5 (10 points): Repeat problem # 2 but use an **8×1 MUX** and external gate(s). Connect ***A, B,* and *C*** to S_2, S_1, and S_0, respectively.

Problem # 6 (10 points): Repeat problem # 2 but use an **8×1 MUX** and external gate(s). Connect ***C, A,* and *D*** to S_2, S_1, and S_0, respectively.