King Fahd University of Petroleum and Minerals
Department of Computer Engineering

DIGITAL LOGIC DESIGN COE 202

Homework 3, December 20, 2008

Problems	Grading
1	
2	
3	
4	
5	
6	
TOTAL	

Student Name:……

Student ID:……

Solve each of the following questions:

1. As a ***design engineer*** your manager asks you to design a circuit that will be used in an electronic safety device used for toddlers. The circuit monitors an area that will be used by toddlers. The area is divided into 4 zones, Z_1, Z_2, Z_3, and Z_4. Each zone has an installed body-heat sensor. If the sensor detects the presence of a toddler in its zone, then the sensor produces a binary "1," and it produces a binary "0" otherwise. Your circuit receives the readings from each sensor installed in each of the 4 zones. Furthermore, your circuit controls 2 light bulbs, L_1 and L_2. Both L_1 and L_2 will be turned **off** (i.e. binary "0") if the circuit detects the presence of **no** toddlers in all 4 zones. Only L_1 will be turned **on** if the circuit detects the presence of toddler(s) in exactly **one** of the 4 zones. Only L_2 will be turned **on** if the circuit detects the presence of toddler(s) in either **two** or **three** of the 4 zones. Both L_1 and L_2 will be turned **on** if the circuit detects the presence of toddler(s) in all 4 zones. Design the circuit using all **NAND** gates.

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

$$X_{A,B,C,D} = \sum(0,4,5,8,9,10,12)$$

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

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

5. 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.

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