COLLEGE OF ENGINEERING & TECHNOLOGY

Department: **Computer Engineering**

Lecturers: **Prof. Dr. Magdy Saeb**

Course: **Digital Systems Design**

Course No.: **CC317**

Date: **June 2005** **Time: 120 minutes** **Grade: 40 Marks**

Student Name:	……	……	**إسم الطالب:**
Registration No.:	……	……	**رقم التسجيل:**
Department:	……	……	**القسم:**
Date:	……	……	**تاريخ الإمتحان:**
Course Title:	Digital Systems Design	**تصميم النظم الرقمية**	**إسم المقرر:**
Semester:	……	……	**الفترة:**

Question No.	Marks
First	
Second	
Third	
Fourth	
Fifth	
Sixth	
Total	

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Marks in Letter	Grade	Signature

- *Solve all of the following problems,*
- *Maximum grade is 100 points.*

Problem 1: **12 Points**
(On Codes)

1.1 Using Hamming code for error detection and correction encode character 'A' which ASCII code is 41_H.

1.2 For the BCD arithmetic code 7421, encode the decimal number 953. Discuss the power consumption of this code as compared to other arithmetic codes that you have studied.

Problem 2: **12 Points**
(On Quine-McCluskey)

Find the internal representation of the Quine-McCluskey data structure of the following expression:

$$P1 = X15.X12'.X10'.X9.X4'.X1.X0$$

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
																t.
																f.

Problem 3: **12 Points**
(On Static Hazards)

Find the static hazard, if any, for the following logic expression:

$$F = WXZ' \cdot YZ \cdot X'Y'$$

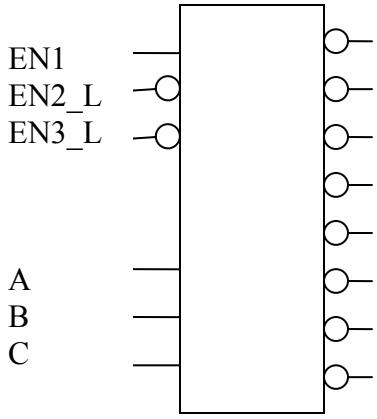
Problem 4: **12 Points**
(On VHDL and decoders)

Complete the following VHDL code :

```
entity V74x138 is
        port (   signal G2A_L, G2B_L: STD_LOGIC;
                 signal G1: STD_LOGIC;
                 signal Y: STD_LOGIC_VECTOR (0 to 7);
                 signal A: STD_LOGIC_VECTOR(2 downto 0));

architecture V74x138_b of  V74x138 is
signal Y_s : STD_LOGIC_Vector (0 to 7);
signal G2A:STD_LOGIC;
signal G2B:STD_LOGIC;
begin
   G2A <= not G2A_L;
   G2B <= not G2B_L;
   Y_L <= not Y;
with A select Y_s ……?
        "..……..?" When "…..?",
        "..……..?" When "…..?",
        "..……..?" When "…..?",
        "..……..?" When "…..?",
        "..……..?" When "…..?",
        "..……..?" When "…..?",
         "..……..?" When "…..?",
        "..……..?" When "…..?",
        "..……..?" When others;
Y <= Y_s when ( G1 and G2A and G2B) = '1' else "…….?";

end V74x138-b;
```



74x138 decoder

Hint: Refer to Figure shown below for the 74x138 decoder symbol.

Problem 5: **12 Points**

(On Switching algebra and notation (T/F))

Indicate whether each of the following equations is true or false. That is, mark "T" if the left-hand-side equals the right-hand side for every possible combination of the input variables, otherwise mark "F".

__(a) $(W \cdot X + Y' + Z)' = (W' + X') \cdot Y \cdot Z'$

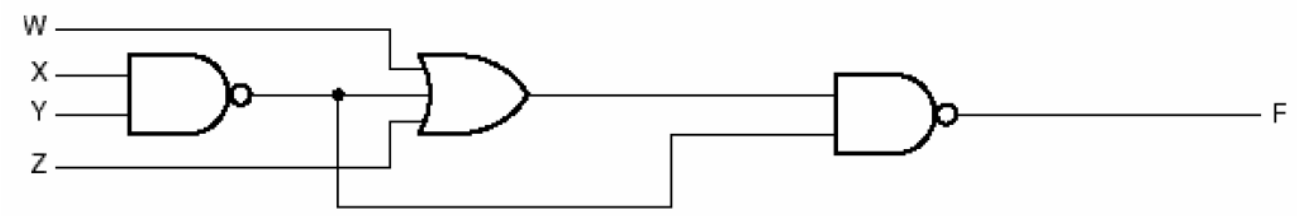
__(b) $W' \oplus X' \oplus Y' \oplus Z = \Sigma_{WXYZ}(0,3,5,6,9,10,12,15)$

__(c) $\Sigma_{WXYZ}(1,6,11,15) = W' \cdot X' \cdot Y' \cdot Z + W' \cdot X \cdot Y \cdot Z' + W \cdot X' \cdot Y \cdot Z + W \cdot X \cdot Y \cdot Z'$

__(d) $\Sigma_{WXYZ}(1,6,11,15) = W' \cdot X' \cdot Y' \cdot Z + W' \cdot X \cdot Y \cdot Z' + W \cdot Y \cdot Z$

Problem 6: **12 Points**
(On Combinational Circuit Analysis)

Write a logic expression for the output F of the circuit below as a function of the circuit inputs (W, X, Y, and Z). Derive the expression directly from the structure of the circuit; do not simplify.



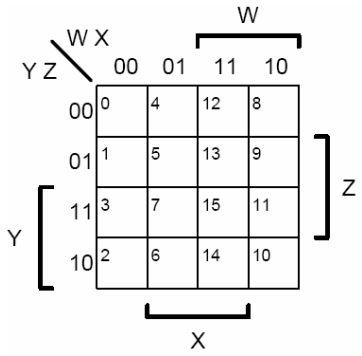
F = _____

Problem 7: **12 Points**
(On Combinational Circuit Minimization)

a) Fill in the Karnaugh map and find a minimal sum of products expression for the function $F = \Sigma W,X,Y,Z(2,6,7,8,9,10,11,15)$.
b) How many additional product terms are in the complete sum for this logic function?

Answer:

a) F = _____
b) No. of additional product terms= _____



Problem 8: **12 Points**
(On the "BUT" Gate)

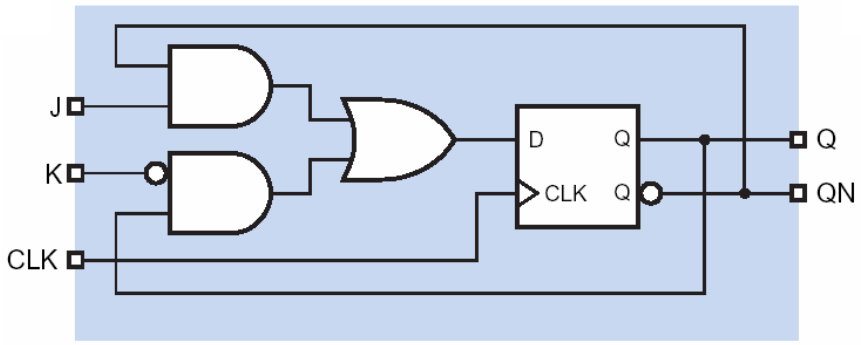
Y1 is 1 if A1 and B1 are both 1 ***but*** A2 and B2 are not both 1;
Y2 is 1 if A2 and B2 are both 1 ***but*** A1 and B1 are not both 1;
Write the truth table for the following two logic statements.

Problem 9: **12 Points**
(On Application Design)

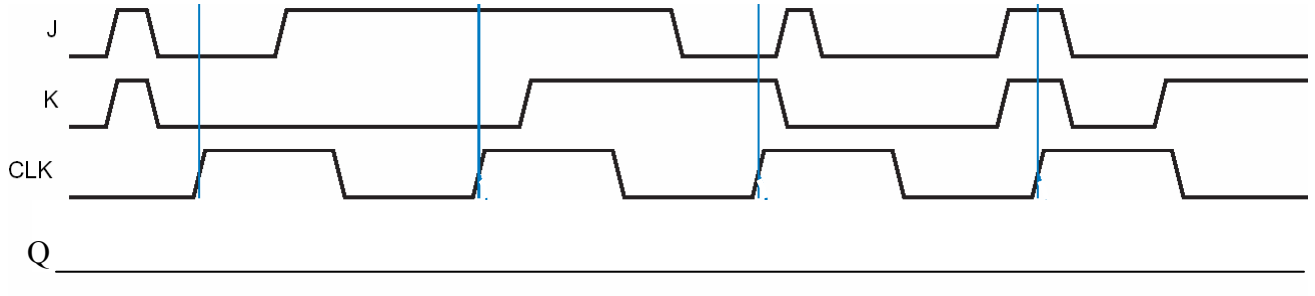
We would like to design a robot maneuvering control system. The robot is equipped with high quality sensors, a front, right and left object detector. This detector sets the "LeftWall" signal, if there is a wall to his left, sets the "RightWall" signal, if there is a wall to his right and finally sets the "FrontWall" signal, if there a wall in front of him. The robot has a motor that enables him to rotate 90° to the left when setting the "TurnLeft" signal, 90° to the right when setting the "TurnRight" signal, and 180° to the right when setting the "TurnAround" signal. You are not allowed to set any two or three signals of the above motor-signals simultaneously. The robot can walk to the front when setting the "Walk" signal. Imagine the robot being inside a room and you want to design a control system for him to get him out of the room. Write the suitable logic equations for each motor-signal that will drive the robot outside the room.

Problem 10: **12 Points**
(On Flip-Flops)

Write the expected output Q and QN in the below truth table. Moreover, draw the output signal Q in the below timing diagram.



J	K	CLK	Q	QN
x	x	0		
x	x	1		
0	0	↑		
0	1	↑		
1	0	↑		
1	1	↑		



Problem 11: **12 points**
(On PLD)

Find the logic expression realized by the following PLD: