TEJ4M1 Unit 5 – Practice Assignment #1 Due: Not To Be Handed In

K&U	/10	APPL	/18	TIPS	/16	COMM	/6

Name:_____Mark:_____/50

A: Logic Translation [APP:_____/8]

Fred or Jane and Marsha will go to the fair, but Fred won't go with Jane or Marsha. Jane and Marsha can only go together since they share a car.

1. Identify this as a *statement* or a *proposition*. State your reason(s) [2]

   This is a _____

   Reason(s)_____

   _____

   _____

2. State appropriate inputs and output for the above. [2]

   _____

   _____

   _____

   _____

   _____

   _____

3. Construct a Truth Table for the above: [2]

4. State the Boolean Equation relating the inputs to the output. [2]

   _____

   _____

B: [K&U:_____/10]

Question 1: **[5 marks]**

Fill in the Truth Table below based on the Karnaugh Map shown to the right. Note: **A, B, C, D** are inputs and **M** represents the output. Show the inputs in standard Truth Table format.

A	B	C	D	M

CD \ AB	00	01	11	10
00	1			1
01		**1**	**1**	
11		**1**	**1**	
10	1			1

Question 2: **[5 marks]**

Prove or disprove using Truth Tables:

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

C: Boolean Algebra Simplification [TIPS:_____/6]

Simplilfy $B \bullet \overline{C} \bullet D + ACD + ABD$.

Step	Left Side	Reason
1	$B \bullet \overline{C} \bullet D + ACD + ABD$	Given
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

$\therefore B \bullet \overline{C} \bullet D + ACD + ABD =$

D: Boolean Algebra Ghost Proof [TIPS:_____/10]

RTP: $\overline{A} \bullet B \bullet \overline{C} + ABD + \overline{A} \bullet \overline{C} \bullet \overline{D} + B \bullet \overline{C} \bullet D + ACD = \overline{A} \bullet \overline{C} \bullet \overline{D} + B \bullet \overline{C} \bullet D + ACD$

For full marks, each line should only be one step and must be justified by either quoting a Rule Number, Operations Rule (COM, ASSOC, DIST) or De Morgan's Laws (DM1 or DM2). **Note:** $A \bullet B$ is the same as AB.

Step	Left Side	Right Side	Reason
1	$\overline{A} \bullet B \bullet \overline{C} + ABD + \overline{A} \bullet \overline{C} \bullet \overline{D} + B \bullet \overline{C} \bullet D + ACD$	$\overline{A} \bullet \overline{C} \bullet \overline{D} + B \bullet \overline{C} \bullet D + ACD$	Given
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			

LS=RS ✓

$\therefore \overline{A} \bullet B \bullet \overline{C} + ABD + \overline{A} \bullet \overline{C} \bullet \overline{D} + B \bullet \overline{C} \bullet D + ACD = \overline{A} \bullet \overline{C} \bullet \overline{D} + B \bullet \overline{C} \bullet D + ACD$

E: De Morgan Transformations [APPL:_____/4]

Find the De Morgan Transformation for: $Y = A\overline{B}C + A\overline{C}$

Step	Expression
	$A\overline{B}C + A\overline{C}$
1	
2	
3	
4	

$\therefore Y = A\overline{B}C + A\overline{C} =$

F: NAND Emulation [COMM:_____/6]

Draw the NAND Emulation circuit for:

$Y = \overline{A} + \overline{BC}$ Note: Your circuit should only contain NAND gates.

G: Karnaugh Maps [APPL:_____/6]

For the following truth table:

a) Show the Karnaugh Map for M. [3]

b) Using the Karnaugh Map, write the minimal Boolean Algebra Expression for M in terms of A,B,C and D. [3]

A	B	C	D	M
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Boolean Algebra Rule Sheet

The table below lists basic rules that are useful in manipulating and simplifying **Boolean Expressions**. Always justify each line of your proof by quoting the Rule Number or Short Form of the expressions listed below.

Number	Rule		
1	$A + 0 = A$	or	$0 + A = A$
2	$A + 1 = 1$	or	$1 + A = 1$
3	$A \bullet 0 = 0$	or	$0 \bullet A = 0$
4	$A \bullet 1 = A$	or	$1 \bullet A = A$
5	$A + A = A$	or	$A + A = A$
6	$A + \overline{A} = 1$	or	$\overline{A} + A = 1$
7	$A \bullet A = A$	or	$A \bullet A = A$
8	$A \bullet \overline{A} = 0$	or	$\overline{A} \bullet A = 0$
9	$\overline{\overline{A}} = A$	or	$A = \overline{\overline{A}}$
10	$A + AB = A$	or	$AB + A = A$
11	$A + \overline{A}B = A + B$	or	$\overline{A}B + A = A + B$
12	$(A + B)(A + C) = A + BC$	or	$(A + C)(A + B) = A + BC$

A, B or C can represent a single variable or a combination of variables.
Write down the rule number in proofs for justification.

DeMorgan's Theorems

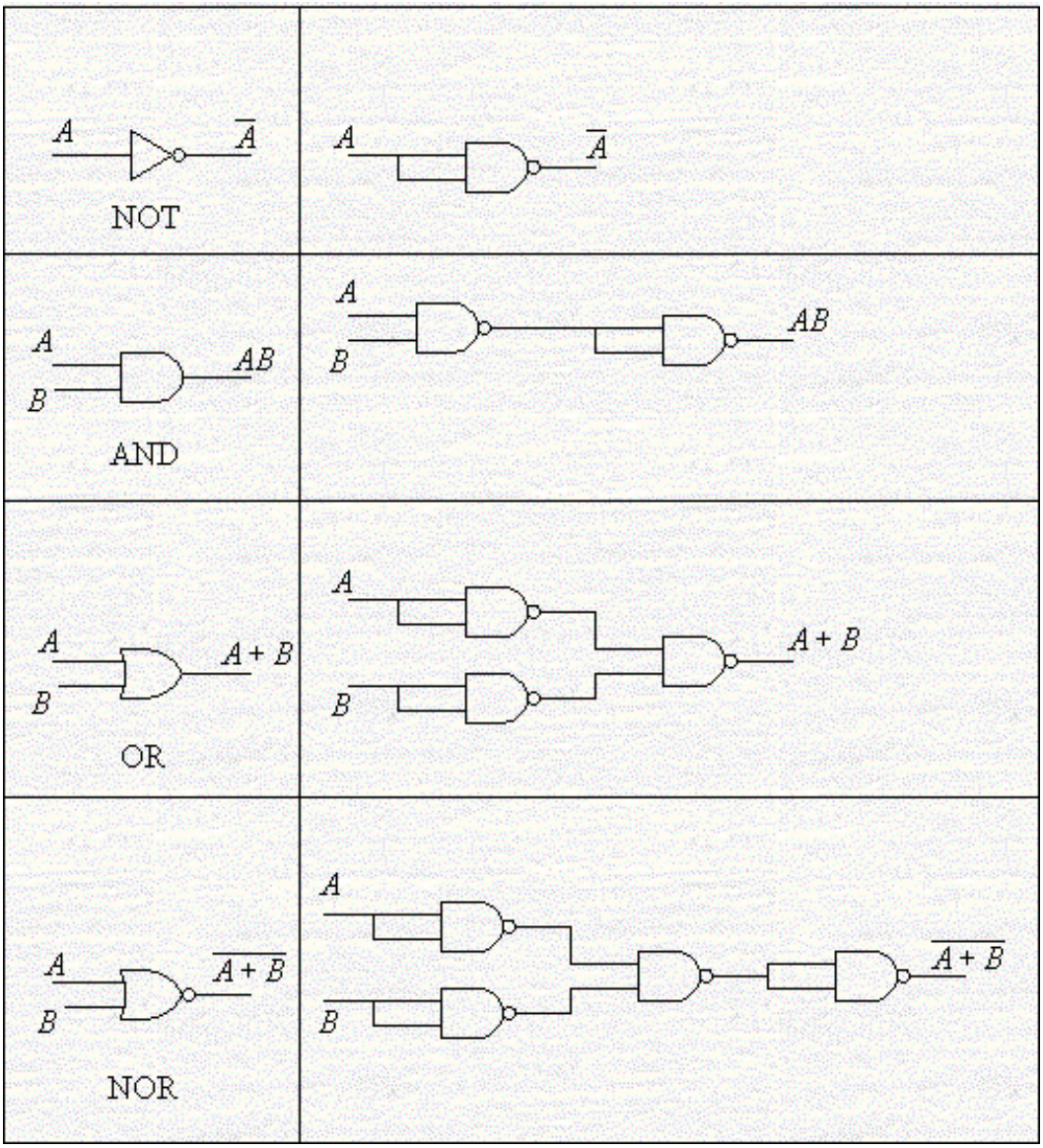
The two theorems developed by DeMorgan are listed below.

Theorem	Short Form
$\overline{X \bullet Y} = \overline{X} + \overline{Y}$	DM1
$\overline{X + Y} = \overline{X} \bullet \overline{Y}$	DM2

Rules of Operation

Law	Example	Short Form
Commutative Law	$A \bullet B = B \bullet A$ $A + B = B + A$	***COM***
Associative Law	$(A \bullet B) \bullet C = A \bullet (B \bullet C)$ $(A + B) + C = A + (B + C)$	***ASSOC***
Distributive Law	$A \bullet (B + C) = A \bullet B + A \bullet C$ $A + (B \bullet C) = (A + B) \bullet (A + C)$	***DIST***

NAND Emulation


A
$\overline{A}$
NOT
A
$\overline{A}$
A
B
AB
AND
A
B
AB
A
B
A + B
OR
A
B
A + B
A
B
$\overline{A + B}$
NOR
A
B
$\overline{A + B}$