	<div style="font-size: 2em; font-weight: bold; margin: 0;">UTM</div> <div style="font-size: 0.8em; margin: 0;">UNIVERSITI TEKNOLOGI MALAYSIA</div>	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> School of Computing </div>
<div style="border: 1px solid black; padding: 5px; display: inline-block; font-weight: bold;">RESEARCH UNIVERSITY</div>		

TEST 2 SEMESTER I 2019/2020

COURSE CODE	:	SECR1013/ SCSCR1013
COURSE TITLE	:	DIGITAL LOGIC
PROGRAM	:	SECR3/BV/P / SECR3/BV/P
TOTAL TIME	:	2 HOUR 30 MINUTES
DATE	:	20 / 11 / 2019
VENUE	:	P19 (DK4, DK5, DK6)

(GENERAL INSTRUCTION):

Write **ALL** your answers for PART A and PART B in the answer booklet.

Write answers for PART A on the first page of answer booklet (compulsory).

Show all your works.

This test will contribute 25% towards the total marks of 100%.

Warning!

Students who are caught cheating during the examination will be reported to the disciplinary board for possible suspension of the student for one or two semesters.

Name	
Metric No	
Year / Course	
Section (Circle)	01 / 02 / 03 / 04 / 05 / 06 / 07 / 08 / 09
Lecturer (Circle)	Irfuz / Zuriahiah / Rashidah

This question booklet consists of 6 pages excluding the front page.

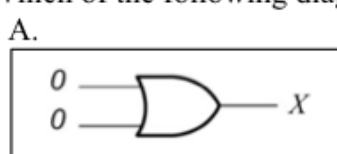
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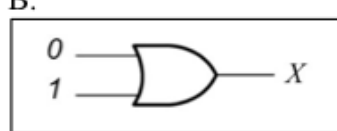
PART A: OBJECTIVE (15 MARKS)


1. If Boolean expression $X = AB\bar{E} + A\bar{B}E$, how many variables are there?
A. 2
B. 3
C. 4
D. 5

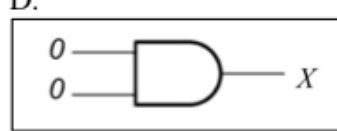
2. Which of the expression below expresses the distributive law?
A. $(A + B) + C = A + (B + C)$
B. $A(B + C) = AB + AC$
C. $A + (B + C) = AB + AC$
D. $A(BC) = (AB) + C$

3. Which of the following diagram proves the Boolean Algebra rule $A.\bar{A} = 0$?

A. 

B. 

C. 

D. 

4. Which Boolean Algebra rule is FALSE?
A. $A + 0 = 0$
B. $A + 1 = 1$
C. $A.\bar{A} = A$
D. $A.1 = A$

5. Which binary value does not match any of the product terms in $AB\bar{C}D + \bar{A}BCD + \bar{A}BC\bar{D} + \bar{A}B\bar{C}D$?
A. 1110
B. 1001
C. 0110
D. 0101

6. Which POS expression match the binary value of 110?
A. $\bar{A}\bar{B}\bar{C}$
B. $\bar{A}\bar{B}C$
C. $A + B + \bar{C}$
D. $\bar{A} + \bar{B} + C$

7. Combinational circuit can be represented as follows EXCEPT:
A. Boolean expression
B. Bar Chart
C. Truth table
D. Logic circuit/Schematic diagram

8. In a K-Map, don't care conditions (X) can be assigned in grouping as _____
A. 0 only
B. 1 only
C. 0 or 1
D. X

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9. In the K-map shown below, which of the groups shown represent a valid grouping?

AB

	00	01	11	10
00	0	1	1	0
01	1	0	0	1
11	0	1	1	1
10	0	1	1	0

CD

i

ii

iii

iv

A. i
B. ii
C. iii
D. iv

10. Given the following standard POS expression shown below, select the correct K-Map representation.

$(A + B + C + D)(A + B + C + D)(A + B + C + D)(A + B + C + D)$

A.

	00	01	11	10
00	1	0	0	1
01	1	1	1	1
11	1	0	0	1
10	1	1	1	1

B.

	00	01	11	10
00	1	1	1	1
01	1	0	0	1
11	1	1	1	1
10	1	0	0	1

C.

	00	01	11	10
00	0	1	1	0
01	0	0	0	0
11	0	1	1	0
10	0	0	0	0

D.

	00	01	11	10
00	1	0	0	1
01	1	1	1	1
11	1	1	1	1
10	1	0	0	1

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11. AND-OR Logic is used to easily implement what type of expression?

A. POS
☒ B. SOP
 C. NAND
 D. NOR

12. Select the correct sequence for gate type in AND-OR-Invert Logic implementation.

A. OR followed by NOT followed by AND gate.
 B. OR followed by AND followed by NOT gate.
 C. AND followed by NOT followed by OR gate.
☒ D. AND followed by OR followed by NOT gate.

13. NAND and NOR are considered to be universal gates because they are capable of performing the logical functionalities concerned to _____.

A. AND gate
 B. OR gate
 C. NOT gate
☒ D. All of the above

14. The input of a NAND gate are connected together. The resulting circuit is _____.

A. NOT
☒ B. OR
 C. AND
 D. NAND

15. 2-input NOR gate is dual symbol equivalent to a _____.

A. negative-OR gate
 B. negative-AND gate
☒ C. negative-AND gate
 D. negative-NOR gate

PART B: STRUCTURED (46 MARKS)

QUESTION 1 (10 MARKS)

a). Draw a logic circuit for the following Boolean expression below. You can only use three gates with 2 input for your drawing. [3]

$$\overline{AB} + \overline{CD}$$

b). Produce a complete truth table for the following logic circuit using the header shown below. Show all your workings. [4]

both same 0
 diff 1

Truth Table Header					
A	B	\overline{A}	\overline{AB}	\overline{A}	\overline{AB}
0	0	1	1	1	1
0	1	1	0	1	0
1	0	0	1	0	1
1	1	0	0	0	0

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c). Draw timing diagram for output $X = A \odot B$ in your answer booklet. Please copy and redraw the timing diagram exactly as shown below in your answer booklet. [1]

A	B	X
1	0	1
0	1	1
1	1	0
0	0	0
1	0	1
0	1	1
1	1	0
0	0	0

QUESTION 2 [7 MARKS]

a). Specify the correct gate for k-v for the following statements: [2.5]

Gate	Statement
i	A HIGH output occurs only when all three inputs are LOW.
ii	A LOW output occurs only when any of the inputs is LOW.
iii	A LOW output occurs only when all eight inputs are HIGH.
iv	A LOW output occurs when the inputs are the same.
v	A HIGH output occurs when any one of one input is HIGH or both inputs are HIGH.

AND
AND
NOR
XOR
OR

b). Draw the circuit using 2 input basic gates only (AND, OR, NOT) to implement Boolean expression $X = [D + (A + B)C] \cdot E + 1$. [4.5] $X = DE + (A+B)E + 1$

QUESTION 3 [10 MARKS]

a). Simplify Boolean expression $Z = (\bar{A} + B) \cdot (A + B)$ using Boolean Algebra laws and rules. Show all your workings. [4]

$$1. Y = \overline{A(B + C)D}$$

$$ii. S = A + \bar{B} + \bar{C}D$$

b). Using DeMorgan's theorem, simplify the following Boolean expressions. Show all your workings. [6]

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QUESTION 4 (13 MARKS)

a). From Boolean expression $S = (A + B)C$ [4]

i. Create and complete the truth table using the following header shown below. Show all your workings. [4]

A	B	C	S

ii. Get standard SOP form from the truth table above.

b). For Boolean expression $X = ABCD + CD + ABC + \bar{D}$, produce SOP simplified expression using K-map minimization. [5]

c). Using K-Map minimization, find POS expression for (2). Show all your workings. [4]

$$W = \pi_{ABCD} (0, 5, 10, 13) + d(2, 7, 8, 15)$$

QUESTION 5 (7 MARKS)

a). Convert the logic circuit below to 2 input NOR universal gate only. Show all your workings. [3]

b). Convert and simplify the NAND only circuit below to 2 input basic gates (AND, OR, NOT). Show all your workings. [4]

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QUESTION 6 (18 MARKS)

Design a combinational circuit that implements and analyze the following functions: [18]

Function Multiply
Multiply two decimals 2 bit numbers A1A0 and B1B0.

Rules:

- OUT1/OUT0 is multiplication result between two decimals numbers in binary.
- OUT1/OUT0 is INVALID if multiplication result between two decimals numbers in binary is LARGER than 3.

Function Compare
Compare two decimals 2 bit numbers A1A0 and B1B0.

Rules:

- EQ set to HIGH if the two decimal numbers are equal
- EQ set to LOW if the two decimal numbers are different

a). Using the following header, create the truth table for the combinational circuit.

INPUT				OUTPUT	
A1	A0	B1	B0	OUT1	EQ

b). From the truth table above, get the simplified SOP expression for OUT1, OUT0 and EQ using K-Map minimization.

c). Draw circuit for OUT1 using 2 input basic gates only (AND, OR).

d). Draw circuit for OUT0 using 2 input basic gates only (AND).

e). Draw circuit for EQ using 4 input basic gates only (AND, OR, NOT).