



MAASAI MARA UNIVERSITY

UNIVERSITY EXAMINATIONS 2018/2019 (REGULAR)

SCHOOL OF SCIENCE AND INFORMATION SCIENCES

**UNIVERSITY EXAMINATIONS FOR THE DEGREE OF
BACHELOR OF SCIENCE (COMPUTER SCIENCE)**

SECOND YEAR FIRST SEMESTER EXAMINATION

COURSE CODE: COM 1205

COURSE TITLE: DISCRETE STRUCTURE II

DATE: 17TH APRIL 2019
11.00AM TO 01.00PM

TIME:

INSTRUCTIONS

Answer Questions ONE and any other TWO

This paper consists of 5 printed pages. Please turn over.

SECTION - A

QUESTION ONE (COMPULSORY 30 MARKS)

a) Convert the following SOP expression to an equivalent POS expression.

$$ABC + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + \bar{A}\bar{B}C$$

(2 Marks)

b) Construct logic networks for the following Boolean expressions, using AND gates, OR gates, and inverters. $(\bar{x} + y)z$

(2 Marks)

c) A group consists of nine men and six women. Find the number of committees of six that can be selected from the class.

(3 Marks)

d) Verify that the proposition $p \vee (p \wedge q)$ is not tautology.

(4 Marks)

e) Use the K-Map and convert the expression into minimal form.

$$\bar{A}\bar{B}CD + \bar{A}BCD + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + B\bar{C}D + BC\bar{D} + A\bar{B}CD + A\bar{B}D + A\bar{B}C\bar{D}$$

(4

Marks)

f) Determine the values of A, B, C, and D that make the sum term $\bar{A} + B + \bar{C} + D$ equal to zero.

(4

Marks)

g) Which of the following expressions is in the sum-of-products (SOP) form?

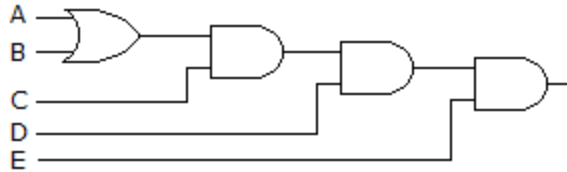
1. $(A + B)(C + D)$

2. $(A)B(CD)$

3. $AB(CD)$

4. $AB + CD$
(2 Marks)

h) Derive the Boolean expression for the logic circuit shown below:



(3

Marks)

i) Compute the truth table of $(F \vee G) \wedge \neg (F \wedge G)$.

(6

Marks)

**SECTION - B:
QUESTION TWO (20 MARKS)**

a) Prove $x + \bar{y} = x + (\bar{x} \cdot \bar{y} + x \cdot \bar{y})$
(5 Marks)

b) Let's consider a propositional language where

- p means "Paola is happy",
- q means "Paola paints a picture",
- r means "Renzo is happy".

Formalize the following sentences:

1. "if Paola is happy and paints a picture then Renzo isn't happy"
2. "if Paola is happy, then she paints a picture"
3. "Paola is happy only if she paints a picture"

(3 Marks)

c) From the truth table below, determine the standard SOP expression.

Inputs			Output
A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

(4

Marks)

d) Use the truth tables method to determine whether $(p \rightarrow q) \vee (p \rightarrow \neg q)$ is valid. (4

Marks)

e) Let's consider a propositional language where

- p: means "x is a prime number",
- q: means "x is odd". Formalize the following sentences:
 1. "x being prime is a sufficient condition for x being odd"
 2. "x being odd is a necessary condition for x being prime"

(4 Marks)

QUESTION THREE (20 MARKS)

a) Prove the associative law: $(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$
(3 Marks)

b) Design a three-input minimal AND-OR circuit L that will have the following truth table:

T= [A=00001111, B= 00110011, C= 01010101; L= 11001101]
(5 Marks)

c) Reduce to Negative Normal Form (NNF) the formula.

$\neg(\neg p \vee q) \vee (r \rightarrow \neg s)$ (2
Marks)

d) Applying De Morgan's theorem to the expression \overline{ABC} , we get _____.

(2

Marks)

e) A truth table for the SOP expression $AB\overline{C} + A\overline{B}C + \overline{A}\overline{B}C$ has how many input combinations?

(2 Marks)

f) Use the K-Map and convert the expression into minimal form.

$$\overline{A}\overline{B}CD + \overline{A}BC\overline{D} + A\overline{B}\overline{C}D + A\overline{B}CD + ABCD + ABC\overline{D} + \overline{A}B\overline{C}\overline{D} + A\overline{B}C\overline{D}$$

(6

Marks)

QUESTION FOUR (20 MARKS)

a) Simplify the expression in to minimal form.

$$Z = f(A,B,C) = \overline{A}\overline{B}\overline{C} + \overline{A}B + AB\overline{C} + AC \quad (2 \text{ Marks})$$

b) Use the truth tables method to determine whether the formula $\phi: p \wedge \neg q \rightarrow p \wedge q$ is a logical consequence of the formula $\psi: \neg p$. (4 Marks)

c) Draw a logic circuit for $AB + AC$. (2 Marks)

d) Define an appropriate language and formalize the following sentences using FOL formulas.

1. All Students are smart.
2. There exists a student.
3. There exists a smart student.
4. Every student loves some student.
5. Every student loves some other student.

6. There is a student who is loved by every other student.
7. Bill is a student.
8. Bill takes either Analysis or Geometry (but not both).
9. Bill takes Analysis and Geometry.
10. No students love Bill. **(5 Marks)**

e) Use the truth tables method to determine whether $p \rightarrow (q \wedge \neg q)$ and $\neg p$ are logically equivalent.

(4 Marks)

f) *Define a propositional language which allows to describe the state of a traffic light on different instants.
With the language defined above provide a (set of) formulas which expresses the following facts:*

1. *the traffic light is either green, or red or orange;*
2. *the traffic light switches from green to orange, from orange to red, and from red to green;*
3. *it can keep the same color over at most 3 successive states.*

(3 Marks)

//END