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 TIME: 11.00AM TO 01.00PM

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 m of committees of six that can be selected from the class.

(3 Marks)

d) Verify that the proposition p ∨ (p ∧ q) is not tautology.

(4 Marks)

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

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

(4 Marks)

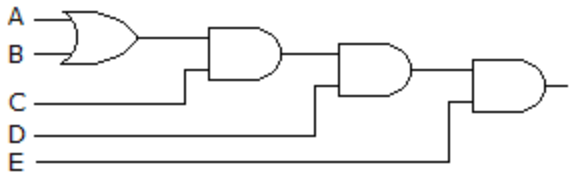
f) Determine the values of A, B, C, and D that make the sum term $\bar{A}$ + B + $\bar{C}$ + D equal to zero. **(4 Marks)**

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 ∨ G) ∧ ¬ (F ∧ 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 → q) v (p → ¬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 $\bar{A}BC$, we get _____.

(2 Marks)

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

(2 Marks)

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

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

(6 Marks)

QUESTION FOUR (20 MARKS)

a) Simplify the expression in to minimal form.

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

b) Use the truth tables method to determine whether the formula φ: p∧¬q → p ∧ q is a logical consequence of the formula ψ: ¬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