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 $p \vee (p \wedge q)$ is not tautology. **(4 Marks)**

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

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

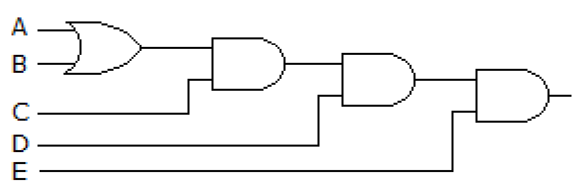
(4 Marks)

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 $(F \vee G) \wedge \neg (F \wedge G)$. **(6 Marks)**

SECTION - B:
QUESTION TWO (20 MARKS)

a) Prove $x + \bar{y} = x + (\bar{\bar{x}} . \bar{y} + \bar{x} . \bar{y})$ **(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 ∧q) ∧r ≡ p∧ (q ∧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.*

¬(¬p∨q)∨(r → ¬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.

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

(6 Marks)

QUESTION FOUR (20 MARKS)

a) Simplify the expression in to minimal form.

$Z = f(A,B,C) = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}B + AB\overline{C} + AC$ **(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 $p \rightarrow (q \land \neg q)$ 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)**

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