UNIVERSITY OF SWAZILAND

Faculty of Science and Engineering

Department of Computer Science

SUPPLEMENTARY/ RESIT EXAMINATION
July 2018

Title of Paper: INTRODUCTION TO LOGIC

Course Number: CSC201

Time Allowed: 3 hours Total Marks: 100

Instructions to candidates:

*This question paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions. Marks are indicated in square brackets.*

All questions carry equal marks.

SPECIAL REQUIREMENTS:

NO CALCULATORS ALLOWED

THIS EXAMINATION PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

Question 1

(a) What is the difference between the two? Give examples. [8]

(i) Tautology and contradiction

(ii) Proposition and an argument

(b) Write the following using propositional logic syntax. (Note: Define all symbols used.) [6]

(i) If it is raining then the road is wet, else it is dry.

(ii) If you go to the beach then bring your books and study.

(iii) A first year student studies both ACS and GNS but not CSC201.

(c) Draw the truth tables of the following propositions.

(i) $\neg P \wedge \neg Q \vee (\neg R \Rightarrow P)$ [6]

(ii) $\neg P \vee \neg Q \wedge \neg P$ [5]

Question 2

(a) Adam, Brian and Claude are suspected of committing a crime. Adam says "Brian is guilty or Claude is innocent." Brian says "If Adam is guilty then so is Claude." Claude says "I didn't do it, one of the others did." Assuming they are all telling the truth, by consistency analysis, find out who is/are guilty. [10]

(b) Prove the following equivalences

(i) $p \wedge \neg q \rightarrow q \vee \neg p \cong \neg p \vee q$

(ii) $(p \wedge q) \rightarrow r \cong p \rightarrow (q \rightarrow r)$

(iii) $(p \vee q) \rightarrow r \cong (p \rightarrow q) \wedge (p \rightarrow q)$ [5 marks each]

Question 3

(a) Construct the circuit diagram for the following Boolean expression. (Do not simplify the expression.) [5]

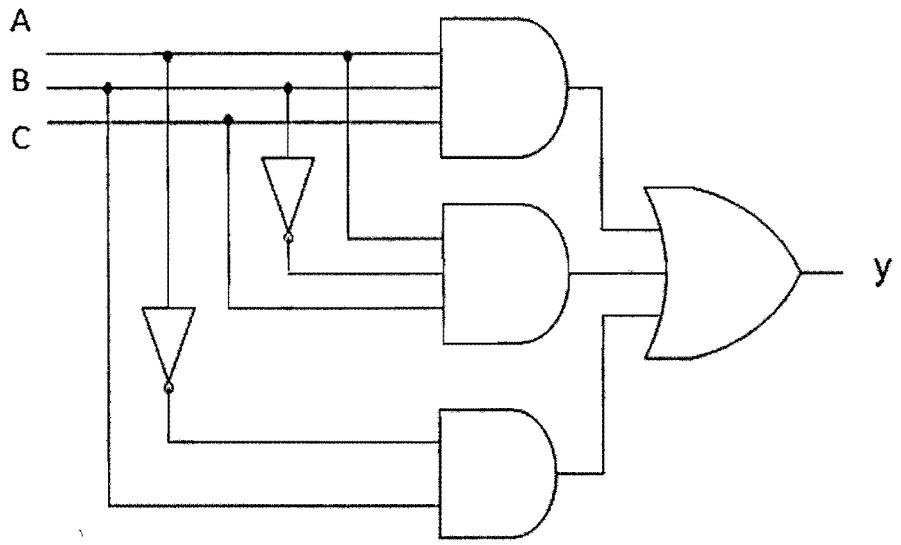
$$\overline{AB + AC} + \overline{A}\overline{B}C$$

(b) Using Boolean algebra laws simplify the expression given in (a) above, and show the simpler circuit diagram. [6]

(c) Using the Quine-McClauskey method, minimize the following function. [10]

$$f(A,B,C,D) = \sum(0,1,4,5,9,12,13)$$

(d) Given the following circuit diagram, write down the expression, *Y*, represented by the circuit. [4]



Question 4

(a) Simplify and draw the circuit of the following function using NAND gates only. [7]

$$f(a,b,c,d) = a\bar{b}cd + ab\bar{c}d$$

(b) With the help of a labelled diagram, explain the operation of a full adder. [10]

(c) Explain the difference between latches and flip flops. [4]

(d) The state the difference between sequential circuits and combinational circuits. Give examples for each. [4]

Question 5

(a) What is the difference between universal quantifiers and existential quantifiers? [4]

(b) Remove universal quantifiers from $\forall x(P(x)) \vee \exists y(\forall z(Q(y, z)))$ [5]

(c) Remove existential quantifiers from $\exists x(Loves(x, Ben)) \wedge \exists y(\neg Loves(y, Ben))$ [5]

(d) By truth table, determine the models (if any) under which the following propositions are consistent with each other.

- $P \Leftrightarrow Q$
- $(P \wedge Q) \Rightarrow Q$

[5]

(e) Find the DNF and CNF of the function with the following truth table. [6]

x	y	z	f(x,y,z)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1