JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

2012/2013 UNIVERSITY EXAMINATIONS

FIRST YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE COMPUTER SECURITY AND FORENSIC

MAIN

COURSE CODE: **SMA 3113**

COURSE TITLE: **LOGICAL FUNCTIONS**

DATE: 15/4/2013 **TIME: 14.00-16.00PM**

INSTRUCTIONS:

1. **Answer question ONE compulsory and ANY other TWO questions in this paper.**
2. **Show all your work clearly in the official answer booklet provided.**

QUESTION ONE- COMPULSORY (30 MARKS)

a. Simplify $\frac{27-6a-a^2}{a^2-7a-18}$ (4mks)

b. Use a set of Venn diagrams to prove the following property of the symmetric difference

$A \cap (B\Delta C) = (A \cap B)\Delta(A \cap C)$ (4mks)

c. Convert $(1100010101100)_2$ to hexadecimal notation hence the base sixteen result to the decimal notation. (4mks)

d. Distinguish between a tautology and a contradiction hence use truth tables to prove whether or not the following is a tautology. $a \vee b \rightarrow (b \rightarrow c)$ (5mks)

e. Given the set $A = \{2,3,4,5,6,7 \ldots,11\}$, determine the truth set for each of the following

i. $(\exists x \in A)(x + 4 < 8)$

ii. $(\forall x \in A)(x + y < 16)$ (3mks)

f. The output Y of a logic circuit is a Boolean expression of the special input sequences $, Band\ C$. Suppose $Y = A'BC + AB'C' + BC'$,

Draw the logic circuit for this case. (5mks)

g. Test the validity of the following argument:

If I study, then I will not fail logical functions

If I do not visit the city, then I will study.

But I failed logical functions

……

Therefore I must have visited the city (5mks)

QUESTION TWO (20 MARKS)

a. Use the knowledge of Boolean algebra to prove that

$xy' + yz' + x'z = x'y + y'z + xz'$ (5mks)

b. Show that $[A \cup (B \cap C)]' = (C' \cup B') \cap A'$ (4mks)

c. Suppose that the universal set is U = {1, 2, 3, 4,5, 6, 7, 8, 9, 10}, while A={3, 4, 5}, B={*1*, *3*, *6*, 10} and C={2, 3, 4, 7, 8, 9} are subsets of the universal set U.

Express each of these set operations as bit strings where the *i*th bit in the string is 1 if *i* is in the resulting set and 0 otherwise.

i. $A \cup (B \backslash C)$

ii. $(B \cup C') \cap A'$ (6mks)

d. Using the same universal set as in the last problem, find

i. the set specified by each of these bit strings

X= 11 1100 1111,

Y= 01 0111 1000 (2mks)

ii. the bit string corresponding to the complement of the symmetric difference of two sets

A={2, 3, 4, 7, 8, 9} and B={1, 3, 6, 9} (3mks)

QUESTION THREE (20MARKS)

a. Test the validity of these arguments:

i. $p \rightarrow q, r \rightarrow q, r \vdash\vdash \neg p$

ii. $p \rightarrow \neg q, \neg p \vdash\vdash q$

(8mks)

b. Construct a combinatorial logic circuit using inverters,OR gates, and AND gates that produces the output

((¬p ∨¬r) ∧¬q) ∨ (¬p ∧ (q ∨ r)) from input bits *p*, *q*, and *r*. (8mks)

c. Let *p*, *q*, and *r* be the propositions

p :You get an A on the final exam.

q :You do every exercise in this book.

r :You get an A in this class.

Write these propositions using *p*, *q*, and *r* and logical connectives (including negations).

i. You get an A in this class, but you do not do every exercise in this book.

ii. You get an A on the final, you do every exercise in this book, and you get an A in this class.

iii. To get an A in this class, it is necessary for you to get an A on the final.

iv. You get an A on the final, but you don't do every exercise in this book; nevertheless, you get an A in this class. (4mks)

QUESTION FOUR (20MARKS)

a. Suppose a logic circuit L has $n = 4$ input devices W,X,Yand Z.

i. Obtain the 16-bit special sequence for each input device

ii. Obtain the output $E = (XY + W^C)Z + (Z^C X^C)^C$ in the hexadecimal form

(9mks)

b. Calculate the binary, octal and hexadecimal equivalent of the following

   i. $(6785)_{10}$

   ii. $(436)_{10}$ (6mks)

c. Make x the subject of the formula $y^2 = (a+x)^2 - (x-a)^2$, hence find the value of x when $y = 15, a = 25$ (5mks)

QUESTION FIVE (20MARKS)

a. A number of people were surveyed to find out how often they went to the movie theatre in one year. The results were as follows:

   15,22,14,12,21,34,19,11,13,0,16,4,23,8,12,18,24,17,14,3

   10,12,9,15,20,5,19,13,17,11,16,19,24,12,7,14,17,10,14,23

   i. Prepare a grouped frequency distribution table for the data.

   ii. Compute mean and standard deviation for the data

   iii. Estimate the quartiles for the data (15mks)

b. For the data 10,7,6,12,3,15,9,17,5,20,6 each value is denoted by x_i , find

   i. $\sum_{i=2}^{8} x_i$

   ii. P_{85}

   iii. $\bar{x}$ (5mks)