THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

SEPTEMBER – DECEMBER 2019 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICS

REGULAR PROGRAMME

PHY 205: DIGITAL COMPUTER ELECTRONICS

Date: DECEMBER 2019	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and ANY other TWO Questions	

Q1. a) Show that $X.Y+(\overline{X.Z})+X.\overline{Y}.Z(X.Y+Z)=1$ **(3 marks)**

b) Determine the complement of the function
Q = $A(\overline{B}.\overline{C}+B.C)$ **(3 marks)**

c) Convert 2AC5.DH to its octal equivalence **(3 marks)**

d) Determine the number of cells in a Karnaugh map for a three input variable **(3 marks)**

e) Draw the truth table for the Boolean function
$X=ABC$ **(3 marks)**

f) The Boolean function Y= AB + CD is to be realized using only 2 input NAND gates. Determine the minimum number of gates required. **(3 marks)**

g) Use K-maps to obtain minimized SOP for each of the following:
(i) Z(A,B,C) = $\sum$ *m*(3,5,6,7) **(2 marks)**
(ii) Z(A,B,C) = $\prod$ *M*(3,5,6,7) **(2 marks)**

h) How many literals and variables does the following function have in this form? F=a'bc+a'bcd+c'd' **(2 marks)**

i) Convert

I $(430)_{10}$ to excess 3 – code **(1 mark)**

II $(101011011010)_2$ to gray code **(1 mark)**

III 011011100011 in gray code to binary **(1 mark)**

j) Give the MAXTERM notation of the following function. f=ab+a'bc'+a'c **(3 marks)**

Q2. a) A bulb in a staircases has two switches, one switch being at the ground floor and the other one at the first floor. The bulb can be turned ON and also can be turned OFF by and one of the switches irrespective of the state of the other switch. The logic of switching of the bulb resembles **(5 marks)**

b) A comparator circuit for a 2 bit binary numbers X = X1X0 and Y = Y1Y0 is to be designed. The outputs are A, B and C where A is 1 if X >Y, B is 1 if X = Y and C is 1 if X < Y. Construct a truth table for the 3 outputs and determine their function as sum of minterms **(10 marks)**

c) Using minterms, show that

$\bar{a}.c+\overline{b}.\bar{c}+a.b=\bar{a}.\bar{b}+b.c+a.\bar{c}$ **(5 marks)**

Q3 a) In the Boolean algebra, verify using the truth table that

$\overline{X}.\overline{Y}.Z+(\overline{Y+Z}).X+\overline{X+Y+Z}+X.\overline{Y}.Z+X.\overline{Y}.\overline{Z}=\overline{Y}$ **(7 marks)**

b) Boolean function f of two variables X and Y is defined as follows:

f(0, 0) = f(0, 1) = f(1, 1) = 1; f(1, 0) = 0

Assuming complements of X and Y are not available, a minimum cost solution for realizing using only 2-input NOR gates and 2-input OR gates (each having unit cost). Determine the total cost. **(7 marks)**

c) Simplify the expression below using a Karnaugh map

$f=\overline{a}.b.\overline{d}+b.c.d+\overline{a}.b.\overline{c}.d+c.d$ **(6 marks)**

Q4. a) Consider the function

F = ab + cd

Build using only three NAND gates. **(5 marks)**

b) (i) Convert $(78)_{10}$ the 8-bit 2' complement binary representation. **(2 marks)**

(ii) Convert A3H to its octal equivalence **(2 marks)**

(i) Convert the unsigned number $(1111101)_2$ to hexadecimal **(2 marks)**

(iv) Convert $(78)_{10}$ the 8-bit 2' complement binary representation. **(2 marks)**

(v) Convert $(4096)_{10}$ into Binary coded decimal **(2 marks)**

c) Draw the logic symbol, diagram and truth table of a full adder illustrating sum output and carry output **(5 marks)**

Q5. a) Distinguish between combinational and sequential circuit **(2 marks)**

b) (i) Draw a combinational logic circuit for
$X = (\overline{\overline{A}\,\overline{B}\,\overline{C}})C + \overline{\overline{A}\,\overline{B}\,\overline{C}} + D$ **(3 marks)**

(ii) Determine the output of the circuit **(3 marks)**

(iii) Show that a simplified circuit is a 4 – input OR gate **(3 marks)**

c) Consider a 4-variable equation
F(A,B,C,D) = $\sum m(1,2,4,6,8, 9,10,14)$
Draw a logic circuit using Karnaugh map **(9 marks)**

END