CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR SCIENCE IN APPLIED COMPUTER SCIENCE

ACSC 102: INTRODUCTION TO DIGITAL LOGIC

STREAMS: **TIME: 2 HOURS**

DAY/DATE: FRIDAY 8/12/2017 **11.30 A.M – 1.30 P.M**

INSTRUCTIONS:

- **Answer question one and any other two questions**

Question One (30 marks)

(a) Discuss three major achievements in the evolution of computers systems. (3 marks)

(b) Discuss the differences between random access and direct access in memory operations. (3 marks)

(c) Using an illustration of an instruction execution, discuss three registers used in the processor during instruction execution. (3 marks)

(d) Discuss three major differences between main memory and the hard disk. (3 marks)

(e) Find the sum of 39_{10} and -15_{10} in binary using the two's complement arithmetic. Use 8 bits to represent the binary numbers. (3 marks)

(f) Perform the following number system conversions.
(i) $6A70F.1B_{16}$ to Octal. (3 marks)
(ii) $997.375_{10}$to Hexadecimal. (3 marks)

(g) Construct a truth table for the Boolean expression shown below. (3 marks)

$$x\bar{y} + xy$$

(h) Draw the combinational circuit that directly implements the following Boolean function. (6 marks)

$$F(x,y,z) = xz + (\overline{\bar{x}y} + \bar{z})$$

Question Two (20 marks)

(a) A three-input digital circuit gives a TRUE output when a majority (i.e. 2 or more) of the inputs is TRUE. Develop a truth table for the output and then draw the logic diagram for the circuit implementation using AND, OR and NOT gates. (9 marks)

(b) Discuss the advantages and disadvantages (if any) of the following cache mapping functions. Explain how the two functions compare. (6 marks)
   (i) Direct mapping
   (ii) Set associative mapping

(c) Simplify the Boolean function using Boolean identities. Show the Boolean identities used in each step. (5 marks)

$$F(x, y, z) = \bar{x}\bar{y}\bar{z} + \bar{x}y\bar{z} + x\bar{y}\bar{z} + xy\bar{z}$$

Question Three(20 marks)

(a) Design a truth table for a three –input exclusive-**OR (XOR)** operation. Design its implementation using AND, OR and NOT gates. (9 marks)

(b) Perform the following number conversions (6 marks)
   (i) 253.475_{10} to base 5
   (ii) $67F0_{16}$ to base 4

(c) Discuss performance balance in the design of computer systems. (5 marks)

Question Four(20 marks)

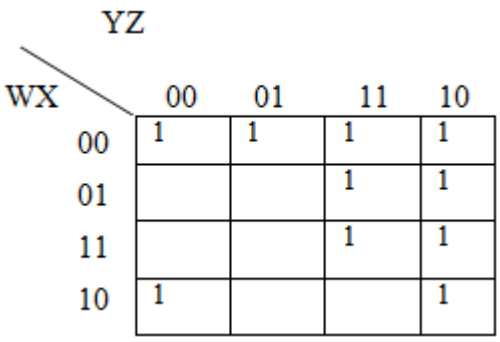
(a) Discuss the following I/O techniques: (9 marks)
   (i) Programmed I/O
   (ii) Direct Memory Access
   (iii) Interrupt Driven I/O

(b) Discuss the flow of program execution in the event of a raised interrupt when interrupts are enabled. (6 marks)

(c) Discuss the computer memory hierarchy. Show why this arrangement is the best so far as used in the design of computer systems. (5 marks)

Question Five(20 marks)

(a) Get the simplified version of the Boolean function represented in the Kmap shown below. Design a logic diagram for the simplified function. (9 marks)



(b) Show that $(X + Y)(X + \overline{Y})(\overline{X} + Z) = XZ$ using Boolean identities. (6 marks)

(c) Explain what cache coherency is and show how write-back and write-through policies are used to achieve it. (5 marks)
