CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL EXAMINATION

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

ACSC 102: INTRODUCTION TO DIGITAL LOGIC

STREAMS: BSC   **TIME: 2 HOURS**

DAY/DATE: FRIDAY 01/09/2023   **11.30 A.M – 1.30 P.M.**

Candidate's Instructions

- Answer question one and any other two questions

Question One (30 marks)

(a) State the difference between Branch prediction and Data flow analysis techniques of improving processor performance. (4 marks)

(b) In the event where there are no interrupts enabled, explain in four steps, the process of instruction execution cycle. (4 marks)

(c) Briefly, discuss how cache memory operates in relation to processor requests for contents. (4 marks)

(d) Construct a truth table for the expression shown below. (4 marks)

$$xyz + \overline{yz}$$

(e) Simplify the following Boolean expression using Boolean identities. Show the identities used at each step. (4 marks)

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

(f) Construct the logic diagram to implement the Boolean expression shown below.

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

(g) 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. (4 marks)

(h) Perform the following number conversions:
   (i) 100111.011_2 to decimal   (3 marks)

   (ii) 797.475_{10} to Hexadecimal.   (3 marks)

Question Two (20 marks)

(a) Discuss the role of the following processor registers   (6 marks)
- (i) Program counter
- (ii) Memory buffer register
- (iii) Instruction register

(b) Using the instruction, ADD x, y where x and y are memory locations, show how the registers in (a) above would be utilized.   (6 marks)

(c) A three-input digital circuit gives a TRUE output when a minority (of 1 or zero) 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.   (8 marks)

Question Three(20 marks)

Consider the Boolean function shown below. Use it to answer the questions that follow.

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

(a) Draw the logic diagram to implement the expression.   (6 marks)
(b) Simplify the expression using Boolean algebra and identities. Show the identities used.   (6 marks)
(c) Construct a truth table for the answer in part b.   (4 marks)
(d) Draw the logic diagram for the simplified expression in part b.   (4 marks)

Question Four(20 marks)

(a) Discuss three major achievements in the evolution of computers systems.   (6 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) Convert the following numbers as advised:
- (i) 3052_8 to Hexadecimal.   (3 marks)
- (ii) 1202221_3 (ternary number) to binary.   (3 marks)
- (iii) Which number systems does the modern computer use and why?   (2 marks)

Question Five(20 marks)

(a) Discuss the cache write policies and why they are important in both shared memory processor set up and other models of multiprocessing set ups.   (5 marks)

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

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

YZ

WX \ YZ	00	01	11	10
00	1			1
01			1	1
11			1	1
10	1			1