

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.

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

- (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			
		00	01	11	10
WX	00	1			1
	01			1	1
	11			1	1
	10	1			1

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