



# MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (TELECOMMUNICATIO & INFORMATION TECHNOLOGY)

SPH 312: COMPUTER ARCHITECTURE & ORGANIZATION

DATE:

TIME:

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## INSTRUCTIONS:

Answer Question One and Any Other Two Questions

### QUESTION ONE (COMPULSARY) THIRTY MARKS

- a) Convert the following numbers:
- $300_{10}$  into the binary number system (2 marks)
  - $100111_2$  into the decimal number system (2 marks)
  - $4320_{10}$  into the octal number system (2 marks)
  - $1010111100_2$  to the hexadecimal system (4 marks)
- b) From the Boolean expression  $F = A\bar{B} + \bar{A}B$ , implement a logical circuit (3 marks)
- c) Minimize the Boolean expression,  $F = ABC\bar{C} + A\bar{B}\bar{C} + B\bar{C}$  and implement using basic logic gates the minimized expression (6 marks)
- d) Using Boolean algebra properties, minimize the Boolean expression  $F = \overline{A\bar{B}(A+C)} + \bar{A}B(A+B+\bar{C})$  and implement the minimized expression using basic logic gates (6 marks)
- e) With reference to ASCII chart, represent the word “yes” in to its equivalent binary format (5 marks)

### QUESTION TWO (20 MARKS)

- a) Describe encoder and decoder as used in digital systems (4 marks)
- b) Design a digital logic circuit that takes 1-bit A and 1-bit B, returning a sum bit S and a carry out bit C as outputs. The design should include:
- Truth table
  - Logic functions
  - Circuit symbols (6 marks)
- c) State the functions of arithmetic and logic unit in a microprocessor (2 marks)
- d) Outline the four basic microprocessor registers stating their functions (8 marks)

**QUESTION THREE (20 MARKS)**

- a) Define combinational logic circuit as used in digital systems (1 mark)
- b) Design and implement a 4x1 data multiplexer showing; truth table, logic gates and circuit symbols (8 marks)
- c) Differentiate between static and dynamic RAM as used in memories (4 marks)
- d) Minimize the following Boolean function using Karnaugh map method  
 $F(A, B, C, D) = \Sigma m(0, 1, 3, 5, 7, 8, 9, 11, 13, 15)$  (5 marks)
- e) Given two binary numbers 10111 and 110001, perform binary addition (2 marks)

**QUESTION FOUR (20 MARKS)**

- a) Minimize the logic function  $F = (A + B + C) \cdot (\bar{A} + B)$  and implement using:
  - i) NOR gates only
  - ii) NAND gates only (10 marks)
- b) Design and implement a 3-to-8 decoder with basic logic gates, showing the truth table (8 marks)
- c) Outline the difference between single-chip microprocessor and single-chip Microcomputer (2 marks)

**QUESTION FIVE (20 MARKS)**

- a) Draw a functional structure of a programmable logic array that implements the logic function  $F = \bar{A} \cdot \bar{B} \cdot C + A \cdot \bar{C}$  using logic gates (6 marks)
- b) With the aid of a block diagram, describe the basic architecture of a microcomputer (8 marks)
- c) Describe memory READ process in a typical microprocessor based system (6 marks)