



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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## UNIVERSITY EXAMINATIONS 2022/2023

SECOND YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF  
BACHELOR OF COMPUTER SCIENCE, BACHELOR OF COMPUTER TECHNOLOGY,  
BACHELOR OF INFORMATION TECHNOLOGY AND BACHELOR OF SCIENCE IN  
SECURITY AND FORENSICS

### SPS 3255/SPS 3250: DIGITAL LOGICS

DATE: APRIL 2023

TIME: 2 HOURS

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**INSTRUCTIONS: Answer Question ONE and any other TWO questions.**

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#### QUESTION ONE (30 MARKS)

- a) What are logic gates? (2 Marks)
- b) Convert  $(128A)_{16}$  to binary and then to decimal (3 Marks)
- c) State two applications of multiplexers (2 Marks)
- d) Simplify the logic expression using Boolean Algebra  
 $Y = A + AB + A\bar{B}C$  (4 Marks)
- e) Why is  $S = R = 1$  not permitted in flip-flops? (3 Marks)
- f) Given the logic expression:  $F = (A + B) + (B + \bar{C})$
- Prepare a truth table (3 Marks)
  - Design a logic circuit to realize the expression (2 Marks)
- g) Design the logic circuits for the logic expressions
- $F = (A + \bar{A}B + C)(B + \bar{A}\bar{C})$  (4 Marks)

- ii.  $F = \bar{A}C(B + BC)$  (2 Marks)
- h) Find ONE's compliment
  - i.  $100100001111_2$  (1 Mark)
  - ii.  $1111101111_2$  (1 Mark)
- i) Prove that  $A + B(A + \bar{B}) = A$  (3 Marks)

**QUESTION TWO (20 MARKS)**

- a) Define the following terms
  - i. Product term (2 Marks)
  - ii. Karnaugh maps (2 Marks)
- b) Convert the logic expression to standard product of sums (POS) form  
 $(A + B + \bar{C})(A + \bar{C})(B + \bar{C})$  (4 Marks)
- c) Given the logic expression  $Y = \bar{A}B + \bar{A}\bar{B}\bar{C} + AB\bar{C} + A\bar{B}\bar{C}$ 
  - i. Convert it to standard SOP form (1 Mark)
  - ii. Map the expression unto K-map (3 Marks)
  - iii. Simplify the expression using K-map (3 Marks)
- d) Convert  $(229)_{10}$  to binary and then to octal (3 Marks)
- e) Add the binary numbers  $11011101_2 + 10000011_2$  (2 Marks)

**QUESTION THREE (20 MARKS)**

- a) Differentiate between a Multiplexer and De-multiplexer. (4 Marks)
- b) Design 32x1 multiplexer using 8x1 multiplexers (4 Marks)
- c) Design a block of a full Adder and then prepare its truth table (6 Marks)
- d) Prove that  $AB + A(B+C) + B(B+C) = B + AC$  (6 Marks)

**QUESTION FOUR (20 MARKS)**

- a) What is a flip-flop? (2 Marks)
- b) State two applications of shift registers (2 Marks)

- c) Differentiate between combinational and sequential logic circuits. (4 Marks)
- d) Prepare a sequence table for a 3-input down counter (3 Marks)
- e) Design a 3-input NAND gate and hence prepare its truth table (3 Marks)
- f) Simplify the logic expression using Boolean algebra  $F = A + AB + A\bar{B}C$ . (6 Marks)