



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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University Examinations 2013/2014

SECOND YEAR, SECOND SEMESTER EXAMINATIONS FOR DEGREE BACHELOR OF  
SCIENCE IN INFORMATION TECHNOLOGY

ICS 2205: DIGITAL LOGICS

DATE: APRIL 2014

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) Convert the following decimal numbers to binary and then to hexadecimal.
- (i)  $(141)_{10}$  (3 Marks)
- (ii)  $(243)_{10}$  (3 Marks)
- (b) Design a 3-input NAND gate and prepare its truth table. (3 Marks)
- (c) What is a flip flop? (1 Marks)
- (d) Prove that  $A + B(A + B) = A + B$  (3 Marks)
- (e) Design logic circuit for the logic expression.  
 $Y = A\bar{B} + \bar{A}\bar{B}C + \bar{A}B$  (3 Marks)
- (f) Convert the Boolean expression to a standard sum of product (Sop) form.
- (i)  $\bar{A} + AB + ABC$  (3 Marks)
- (ii)  $AB + A\bar{C} + BC$  (3 Marks)
- (g) Add the hexadecimal numbers
- (i)  $0B + 12F$  (2 Marks)
- (ii)  $31C + 10D$  (3 Marks)

**QUESTION TWO – (20 MARKS)**

- (a) Find two's complement
- (i)  $(1001001)_2$  (2 Marks)
  - (ii)  $(1110010)_2$  (2 Marks)
- (b) Convert the octal numbers to decimal
- (i)  $(547)_8$  (2 Marks)
  - (ii)  $(375)_8$  (2 Marks)
- (c) Prepare a truth table of the logic expression  
 $Y = \overline{A + B} + C$  (3 Marks)
- (d) Simplify the logic expression using Boolean Algebra
- (i)  $(\overline{A} + B)(A + B)$  (3 Marks)
  - (ii)  $A + \overline{A}B + A\overline{B}$  (4 Marks)
- (e) What are logic gates? (2 Marks)

**QUESTION THREE – (20 MARKS)**

- (a) Define the following terms
- (i) K-maps (2 Marks)
  - (ii) Product term (2 Marks)
- (b) Convert the following Boolean expressions to a standard sum of product (SoP) form
- (i)  $\overline{A} + AB + ABC\overline{C}$  (2 Marks)
  - (ii)  $(AB + A\overline{C} + BC)$  (2 Marks)
- (c) Convert the following Boolean expressions to a standard product of sums (POS) form
- (i)  $(A + B)(\overline{A} + C)$  (2 Marks)
  - (ii)  $(A + \overline{B} + C)(\overline{B} + C)(A + \overline{C})$  (2 Marks)
- (d) Given the logic expression  
 $x = \overline{A}B + \overline{A}\overline{B}\overline{C} + AB\overline{C} + A\overline{B}\overline{C}$
- (i) Convert it to standard SOP form. (1 Mark)
  - (ii) Simplify the expression using K-map. (5 Marks)
  - (iii) Prove that  $AC + ABC = AC$  (2 Marks)

**QUESTION FOUR – (20 MARKS)**

- (a) Differentiate between combinational and sequential logic circuits. (4 Marks)
- (b) Design the circuit of S – R flip –flop using NAND gates. (3 Marks)
- (c) Implement a NOT gate (inverter) using NOR gates only. (4 Marks)
- (d) Design logic circuits for the logic expressions
- (i)  $Y = A\bar{B} + A(\bar{B} + \bar{C})$  (3Marks)
- (ii)  $Y = \overline{A(B + \bar{A}\bar{C})}$  (3 Marks)
- (e) What is race around conditions in flip flops? (3 Marks)