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University Examinations 2013/2014

SECOND YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY AND BACHELOR OF BUSINESS INFORMATION TECHNOLOGY

ICS 2205: DIGITAL LOGICS

DATE: DECEMBER 2013 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer questions **one** and any other **two** questions*

QUESTION ONE - (30 MARKS)

a) Convert the following decimal numbers to binary and then to hexadecimal
   i. $(125)_{10}$ (3 Marks)
   ii. $(256)_{10}$ (3 Marks)
b) Implement a NOT gate using NAND gates only. (3 Marks)
c) State two applications of flip-flops. (2 Marks)
d) Simplify the logic expression using Boolean Algebra.
   $Y = AB + \bar{A}B + \overline{AB}$. (3 Marks)
e) Design a logic circuit given the logic expression
   $Y = (A + \bar{B})(\bar{B} + C)B$. (3 Marks)
f) Why is S=R=1 not permitted in the S-R flip-flops? (2 Marks)
g) Simplify the logic expression using k-map
   $F = A\bar{B} + \bar{A}\bar{B} + AB$ (3 Marks)
h) i) Design a 2-input exclusive NOR gate. (1 Mark)
   ii) Prepare a truth table for the above gate. (2 Marks)
i) Add the hexadecimal numbers
   i. OB7F + 09C (3 Marks)
   ii. A2C+128D (2 Marks)

QUESTION TWO (20 MARKS)

a) Find the Two's compliment
   i. 0100100. (2 Marks)
   ii. 0100111 (2 Marks)

b) Design logic circuits using gates to realize these functions
   i. $F = \overline{AB} + AB\bar{C} + BC$ (3 Marks)
   ii. $y = (A + BC)(B + \bar{C}A)$. (3 Marks)

c) What are logic gates? (2 Marks)

d) Convert the octal numbers to binary and then to decimal.
   i. $(42)_8$ (2 Marks)
   ii. $(426)_8$ (3 Marks)

e) Simplify the logic expression using Boolean Algebra.
   $x = \bar{A}B + A + \bar{A}\bar{B}$ (3 Marks)

QUESTION THREE (20 MARKS)

a) Define the following terms
   i. Product term. (2 Marks)
   ii. Domain (2 Marks)

b) Convert the following Boolean expression to a standard sum of products (SOP) form
   i. $\bar{A} + AB + AB\bar{C}$ (2 Marks)
   ii. $A\bar{B} + A\bar{C} + C + \bar{A}\bar{B}C$ (3 Marks)

c) Convert the following Boolean expressions to a standard product of sums (POS) form
   i. $(A + B)(\bar{B} + C)$ (2 Marks)
   ii. $(A + \bar{C})(A + \bar{B} + \bar{C})(A + \bar{B})$ (2 Marks)

d) Map the logic expression onto k-map
   $y = \bar{A}B\bar{C}D + \bar{A}BCD + AB\bar{C}D + ABCD + ABC\overline{D} + A\bar{B}CD + A\bar{B}C\overline{D}$. (4 Marks)

e) Prove that $A + B(A + B) = A + B$. (3 Marks)

QUESTION FOUR (20 MARKS)

a) Differentiate between JK and S-R flip – flops. (4 Marks)

b) Explain briefly "race around condition" in flip-flops. (4 Marks)

c) Design a logic circuit for the logic expression and hence prepare its truth table.
   $y = \bar{A}BC + A\bar{B}C + AB\bar{C}$ (6 Marks)

d) Develop a logic circuit with 3-input variables that will produce a 1 output when exactly two input variables are 1's. (4 Marks)

e) Differentiate between set and reset inputs in flip-flops. (2 Marks)