MACHAKOS UNIVERSITY

University Examinations for 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

FIRST YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

SIT 112: INTRODUCTION TO DIGITAL ELECTRONICS

DATE: 19/12/2017 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS: Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

a) i All the number systems used in digital electronics have positional value notation. Explain the meaning of positional value basing your argument on decimal number systems. (1 mark)

ii Convert the binary number 11001_2 into decimal form (1 mark)

iii Convert $23A_{16}$ into its binary equivalent. (1 mark)

b) Perform the following binary operations

i Add 110011_2 to 101101_2 (1 mark)

ii Subtract 01011_2 from 10110_2 (1 mark)

iii Multiply 111_2 by 101_2 (1 mark)

c) i Carry out the binary division 11011_2 by 100_2 (1 mark)

ii Find the equivalent decimal value for the BCD coded number 0001010001110101 (2 marks)

d) i Write 9 and 14 in excess-3 code (1 mark)

ii Express the word "KEY" in the American standard code for information interchange (2 marks)

e) i Explain briefly using simple block (logic) diagram of a simple digital system how human language is converted into machine language and vice versa (2 marks)

ii Construct the truth table of 3-input OR gate with inputs A, B, C and output D (2 marks)

f) i Prove the following Boolean identity $(A + B)(A + C) = A + BC$ (2 marks)

ii Simplify the Boolean expression $Y = AB\bar{C}\bar{D} + \bar{A}B\bar{C}\bar{D} = B\bar{C}D$ show the minimum logic gate implementation (3 marks)

g) i Design a logic hardware based on the Boolean expression AB+C (2 marks)

ii Find the Canonical Sum of products (SOP) form of the expression $f(A, B, C, D) = AB + \bar{A}.\bar{B} + AC + \bar{A}.\bar{C}$ (2 marks)

h) i Construct the truth table of an Half-Adder (2 marks)

ii Define the following term Flip-Flop (1 mark)

iii Draw a logic diagram of a mod -8 ripple counter using three JK flip-flops (2 marks)

QUESTION TWO (20 MARKS)

a) Perform the following Boolean operations (4 marks)

i) 1011.01 + 1001.11

ii) 110.01 - 100.10

iii) 101.00 x 11

iv) $11.11 \div 0.101$

b) Convert the following numbers in their respective forms (6 marks)

i) Decimal 1996 to an equivalent binary number

ii) Octal 3711 to its decimal form

iii) Hexadecimal CD42 to its decimal systems

c) Subtract

i) $(1011101)_2$-$(1101100)_2$ using the 1's complementary method (2 marks)

ii) $(1010)_2$-$(1101)_2$ using the 2's complementary method (2 marks)

d) A seven bit Hamming code is received as 1101101.Locate the error position and give the correct code (6 marks)

QUESTION THREE (20 MARKS)

a) i Define the term logic gate as used in digital circuits (1 mark)

ii The AND gate represents a logic Boolean multiplication. Draw the logic symbol for a 3-input AND gate. Give its equivalent switching circuit and construct the corresponding truth table (4 marks)

b) i The NOR gate is a universal gate. Draw the logic symbol of NOR gate .Explain how it is used as an AND gate and draw the gate implementation diagram (3 marks)

ii Construct the truth table for a 2-input NAND gate and explain the NAND gates operations as compared to the AND gate. (2 marks)

c) Prove the following identities using Boolean algebra and De Morgan's theorem

i) $\overline{AB + BC + CA} = \bar{A}\,\bar{B} + \bar{B}\,\bar{C} + \bar{A}\bar{C}$ (2 marks)

ii) $\overline{\bar{A}\bar{B} + \bar{A} + AB} = 0$ (1 mark)

d) i Design the logic circuit whose output is given by the Boolean expression

D=(A+B).C

Evaluate D when A=0, B=1, C=1 and when A=1, B=1,C=0 (3 marks)

ii Design the logic circuit using NAND gates only to implement the following Boolean expression.

Y=ABC+DEF (4 marks)

QUESTION FOUR (20 MARKS)

a) i Differentiate between min terms and max terms as used in karnaugh map method of Boolean expression simplification (2 marks)

ii Find the sum of min terms and function f(A,B,C,D) in canonical sum of products form for the function f(A,B,C,D)=A.C (4 marks)

b) Obtain the minimal expression for the Boolean switching functions given below using the Karnaugh map method f(W,X,Y,Z)=∑(0,1,2,3,4,8,9,10,15) (5 marks)

c) From the truth table below, find the max terms or conical POS forms of function f (A, B, C). (5 marks)

A	B	C	D
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

d) Construct the truth table for binary full adder which adds three bits of binary data producing a sum bit, S and a final carry bit ,C (4 marks)

QUESTION FIVE (20 MARKS)

a) With the help of a logic circuit of an half adder using NOR gates show how the sums and carry (C) operation are carried out. (5 marks)

b) Differentiate between the following terms as used in a logic circuit of digital circuits

i Synchronous sequential circuits and unsynchronous sequential circuits (2 marks)

ii Multiplexer and De multiplexer (2 marks)

c) i) Construct the Reset-set flip-flop using two cross – coupled NAND gates (3 marks)

ii) Draw the logic circuit diagram of a four stage shift-left register with D-flip-flops (4 marks)

d) Construct the table showing the counting sequence for a 4-bit (mod-16) serial counter (4 marks)