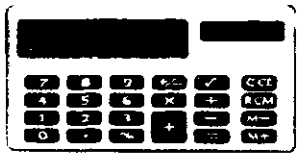
UNIVERSITY EXAMINATIONS



UNIVERSITEITSEKSAMENS

UNISA university of south africa

DIG1501

May/June 2017

DIGITAL SYSTEMS I (THEORY)

Duration 3 Hours

100 Marks

EXAMINERS

FIRST	MR PO UMENNE
SECOND	MR NR NETSHIKWETA

Programmable pocket calculator is permissible

Closed book examination

This examination question paper consists of 6 pages including the cover page and a formula sheet

Answer all the questions

PLEASE NOTE; IF YOU HAVE THE OPINION THAT INSUFFICIENT INFORMATION IS SUPPLIED FOR YOU TO ANSWER A PARTICULAR QUESTION, MAKE A REALISTIC ASSUMPTION, MOTIVATE IT AND THEN ANSWER THE QUESTION.

NUMBER SYSTEMS, OPERATION AND CODES

QUESTION 1

1 1 In the 2's complement form, the binary number 10010011 is equal to which decimal number

(4)

1 2 Determine the decimal value of the following signed binary number in the 2's complement form

10011001 (4)

[8]

QUESTION 2

The binary number 10001101010001101111 can be written in hexadecimal as _____ (3)

[3]

LOGIC GATES

QUESTION 3

Determine the output waveform in figure 1 below and draw the timing diagram. (5)

[5]

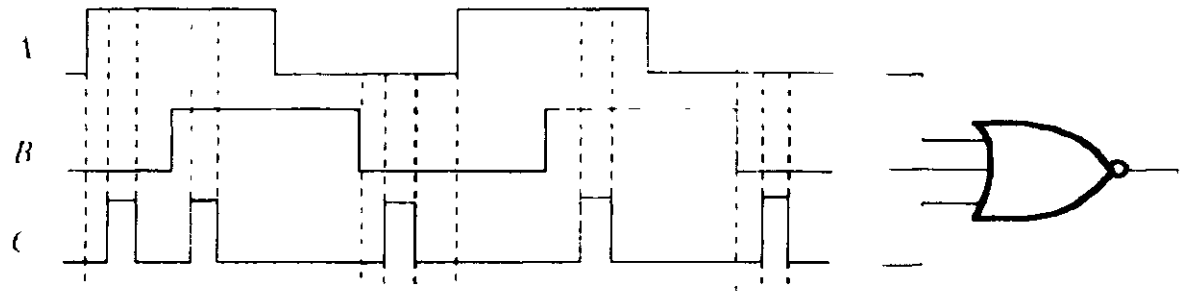


Figure 1

QUESTION 4

For the set of input waveforms in figure 2, determine the output for the gate shown and draw the timing diagram (5)

[5]

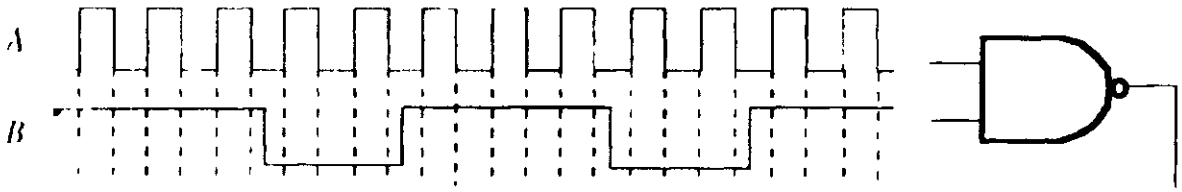


Figure 2

BOOLEAN AGEBRA AND LOGIC SIMPLIFICATION

QUESTION 5

5 1 Apply DE Morgan's theorem to the expression below

$\overline{(CD + \bar{E}F)(\overline{A\bar{B}} + \overline{\bar{C}\bar{D}})}$ (6)

5 2 Using Boolean algebra simplify the following expression

$(B + BC)(B + \bar{B}C)(B + D)$ (6)

5 3 Use a Karnaugh map to find the minimum SOP form for the following expression

$\bar{A}(BC + B\bar{C}) + A(BC + B\bar{C})$ (8)

5 4 Use a Karnaugh map to reduce the following expression to a minimum SOP from

$\bar{A}B(\bar{C}\bar{D} + \bar{C}D) + AB(\bar{C}\bar{D} + \bar{C}D) + A\bar{B}\bar{C}D$ (10)

[30]

COMBINATIONAL LOGIC ANALYSIS

QUESTION 6

6 1 Develop the truth table for the circuit in figure 3 below (16)

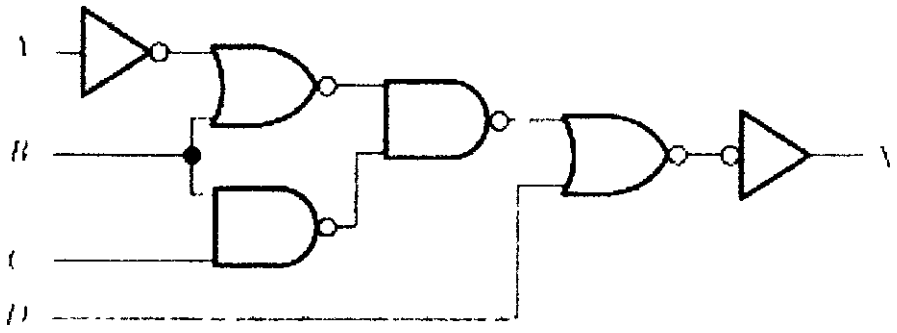


Figure 3

6 2 Given the logic circuit and the input waveforms in figure 4 below, sketch the output waveform (6)

Figure 4

[22]

FUNCTIONS OF COMBINATIONAL LOGIC

QUESTION 7

7.1 The waveforms in figure 5 below are applied to the comparator as shown. Determine the output (A = B) waveform (6)

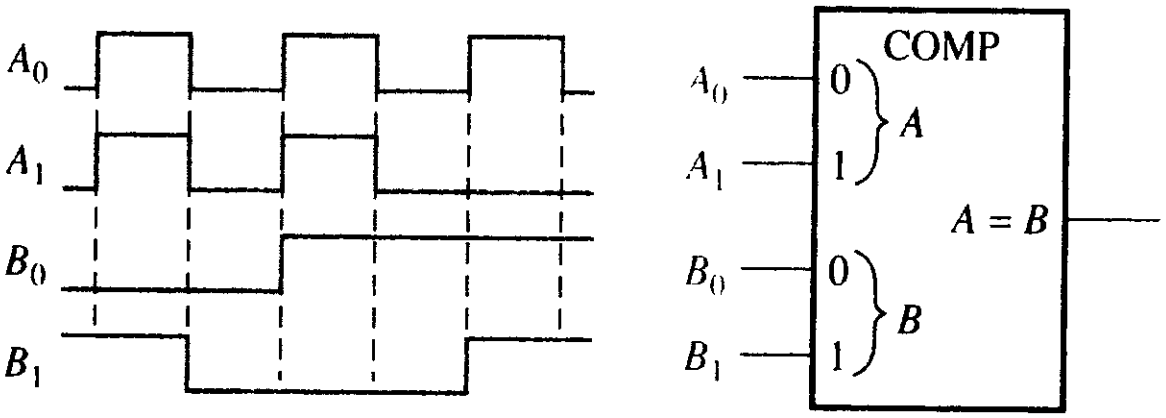


Figure 5

7.2 BCD (Binary coded decimal) numbers are applied sequentially to the BCD-to-decimal decoder in figure 6 below. Draw a timing diagram, showing each output in the proper relationship with the others and with the inputs. (Hint A_3 is the most significant bit). (10)

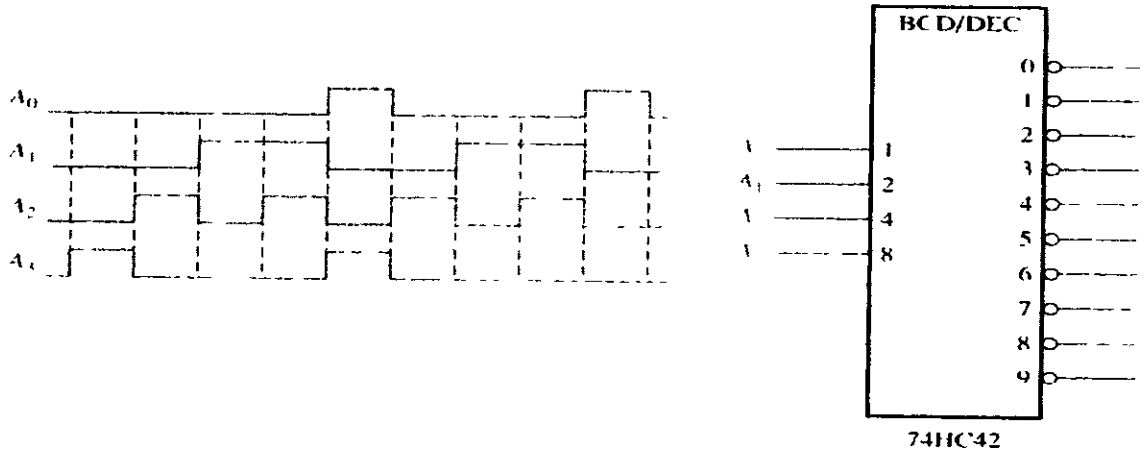


Figure 6

7 3 For the parallel adder in figure 7 below determine the complete sum by analysis of the logical operation of the circuit Verify your result by long hand addition of the two input numbers. (11)

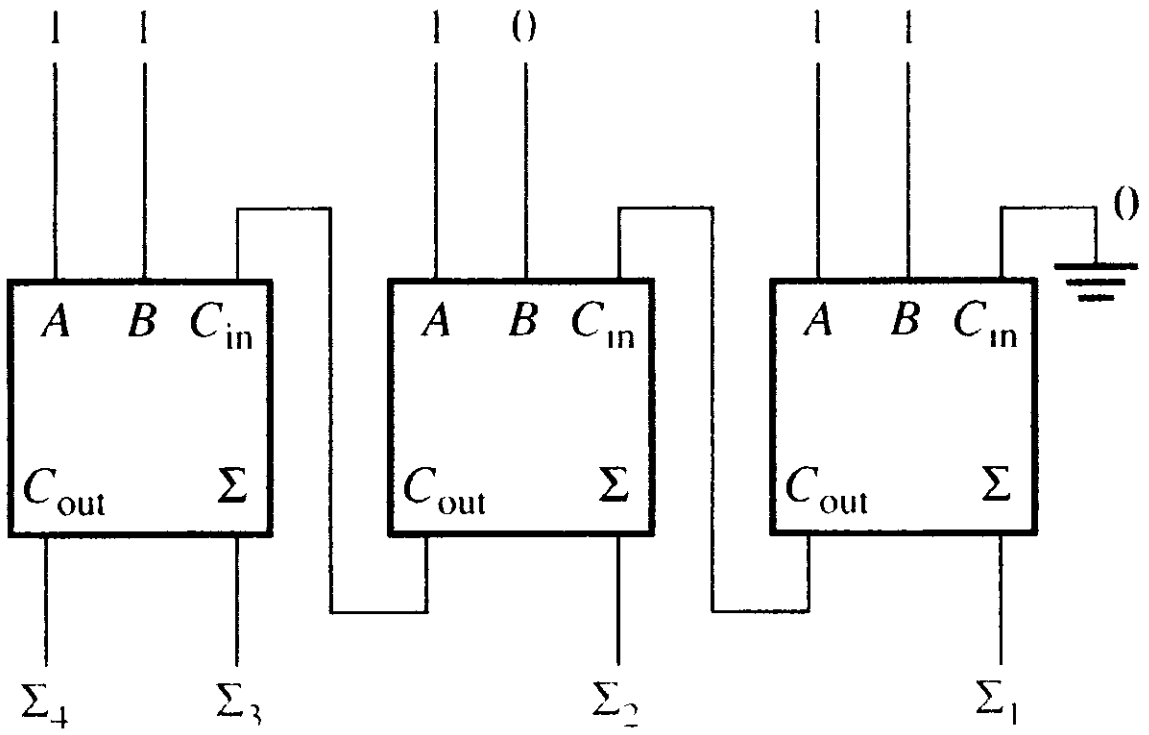


Figure 7

[27]

Total Marks [100]

DIGITAL SYSTEMS 1

FORMULAE SHEET

Basic Laws

$X \bullet 0 = 0$ $\quad X + 1 = 1$ $\quad X \bullet \overline{X} = 0$

$X + 0 = X$ $\quad X \bullet X = X$ $\quad X + \overline{X} = 1$

$X \bullet 1 = X$ $\quad X + X = X$ $\quad \overline{\overline{X}} = X$

Commutative Laws

$X \bullet Y = Y \bullet X$ $\quad X + Y = Y + X$

Associative Laws

$(X + Y) + Z = X + (Y + Z) = X + Y + Z$

$(X \bullet Y) \bullet Z = X \bullet (Y \bullet Z) = X \bullet Y \bullet Z$

Distributive Laws

$X \bullet (Y + Z) = (X \bullet Y) + (X \bullet Z)$

$X + (Y \bullet Z) = (X + Y) \bullet (X + Z)$

De Morgan's Theorem

$\overline{X \bullet Y} = \overline{X} + \overline{Y}$ $\quad X + Y \quad \overline{X} \bullet \overline{Y}$

Logic Theorems

$X + X \bullet Y = X$ *(Absorption)*

$X + \overline{X} \bullet Y = X + Y$

$X \bullet Y + X \bullet \overline{Y} = X$ *(logical adjacency)*

$X \bullet Z + \overline{X} \bullet Y \bullet Z = X \bullet Z + Y \bullet Z$

$X \bullet Y + X \bullet Z + \overline{Y} \bullet Z = X \bullet Y + \overline{Y} \bullet Z$