SEMESTER EXAMINATION (SAMPLE No 2)

SAS code: **EXAM**

Diploma in Electrical and Electronic Engineering DEEE 1st Year FT /EO

Diploma in Computer Engineering DCPE 1st Year FT

Diploma in Aerospace Electronics DASE 1st Year FT

Diploma in Clean Energy DCEG 1st Year FT

Diploma in Common Engineering DCEP 1st Year FT

DIGITAL ELECTRONICS 1

Time Allowed : 2 hours

Instructions to Candidates

1. The attention of candidates is drawn to the Rules of Conduct of Examination found on the back of the Answer Booklet.

2. This paper consists of **THREE** sections:
   Section A - 10 Multiple Choice Questions, 2 marks each.
   Section B - 6 Short Questions, 10 marks each.
   Section C - 1 Long Question of 20 marks.

3. Answer **ALL** questions in the accompanying Answer Booklet, unless otherwise indicated. Start each question in Sections B and C on a new page.

4. This Examination Paper consists of 9 pages.

5. Your admission number and module class must be entered in the box provided on the cover page of your Answer Booklet.

Multiple choice question answer procedure

Please tick the correct answer in the box provided at the back of the cover page in the answer booklet. No marks will be deducted for incorrect answers.

Section A Multiple Choice Questions (20 Marks)

1. Which one of the following quantities is digital?

(a) The amount of fuel consumed by a ship over a period of exactly 14 days.
(b) The electrical energy consumed by a personal computer in 12 hours.
(c) The amount of liquid in a cylindrical container of capacity 2000cc.
(d) The letters A to Z in the English alphabet.

2. In the Hexadecimal number system, the number which is 2_{16} greater than 199_{16} is

(a) 201_{16} (b) $1A0_{16}$
(c) $1A1_{16}$ (d) $19B_{16}$

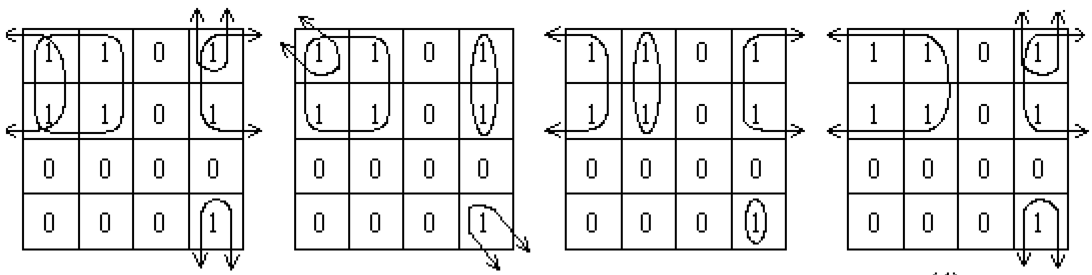
3. How many D flip-flop(s) are required to store a 3-digit octal number?

(a) 3_{10} (b) 8_{10}
(c) 9_{10} (d) 12_{10}

4. Which one of the following Boolean expressions is equivalent to a three-input AND gate?

(a) $\overline{\overline{A}+\overline{B}+\overline{C}}$ (b) $A+B+C$ (c) $\overline{A\cdot B\cdot C}$ (d) $\overline{A}\cdot\overline{B}\cdot\overline{C}$

5. Which one of the following is the best and correct way of looping the given K-map?



(a) (b) (c) (d)

6. In applying the Karnaugh Map to simplify a 4-variable Boolean expression, which one of the following guidelines is **incorrect**?

(a) When grouping ones (1's), group as many adjacent ones as possible as long as the grouping consists of an even number of ones.

(b) If there are ones (1's) in the four corners of the K-map, then they can be grouped together as a quad of ones (1's).

(c) The largest possible number of ones (1s) that can be grouped together is sixteen (16).

(d) Grouping eight (8) adjacent ones (1's) would eliminate three (3) variables that appear in both true and complement form.

7. A non-retriggerable monostable has a triggered pulse duration (t_p) of 1µS. What will be the response at the true (Q) output, if the monostable is triggered again while it is 500nS into its quasi-stable state from a preceding trigger?

(a) There is no change, it remains H for another 500nS before returning to L.

(b) It remains H for another 1µS and thereafter, it goes L.

(c) It will remain High until the next trigger is received.

(d) The output Q goes back to its stable state immediately.

8. A multivibrator with **no** stable states is also known as a:

(a) Astable multivibrator
(b) Bistable multivibrator
(c) Monostable multivibrator
(d) Schmitt trigger

9. How many different sets of input combinations will produce a High from a 6-input NOR gate?

(a) 1_{10} (b) 6_{10} (c) 63_{10} (d) 64_{10}

10. The best and correct approach in converting a Binary number to Hexadecimal is to:

(a) Repeatedly divide the Hexadecimal number by 16 and take the remainders.

(b) Convert the binary number to decimal and then use the repeated division by 16 method to convert Decimal to Hexadecimal.

(c) Multiply each binary digit by powers of 16 and then sum up the products to obtain the Hexadecimal equivalent.

(d) Group the Bits into groups of fours (starting at the binary point) and then convert each group of four bits directly to one Hexadecimal digit.

Section B Short Questions (60 marks)

B1 (a) List the complete Hexadecimal counting sequence from FC_{16} to 103_{16}

(b) Convert Hexadecimal $FA67_{16}$ to Binary.

(c) Convert Decimal 367_{10} to Binary.

(d) Convert Binary 1101100111_2 to Octal or base 8.

(10 marks)

NB: All workings in question B1 must be shown or marks will not be awarded.

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B2. (a) Using Boolean theorems, simplify the following Boolean expression:

$$Y = \overline{\overline{A(\bar{B}C + B\bar{D})} + \overline{AB}}$$

(5 marks)

(b) Given the Karnaugh Map as shown in figure B2, obtain the minimum Boolean expression in the sum-of-products form. Hence implement the simplified expression using the minimum number of basic gates.

(5marks)

X	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	0	0	1
$\bar{A}B$	0	0	0	0
AB	0	1	1	0
$A\bar{B}$	1	1	1	1

Figure B2

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B3 Given the waveforms at the PRE, CLR, Din and the CLK inputs of the D flip-flop as shown in figure B3 sketch the corresponding output waveform Z in the space provided. Write your admission number in the box provided at the top of the page.

(6 marks)

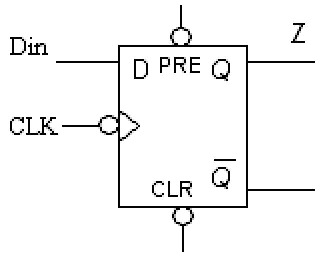
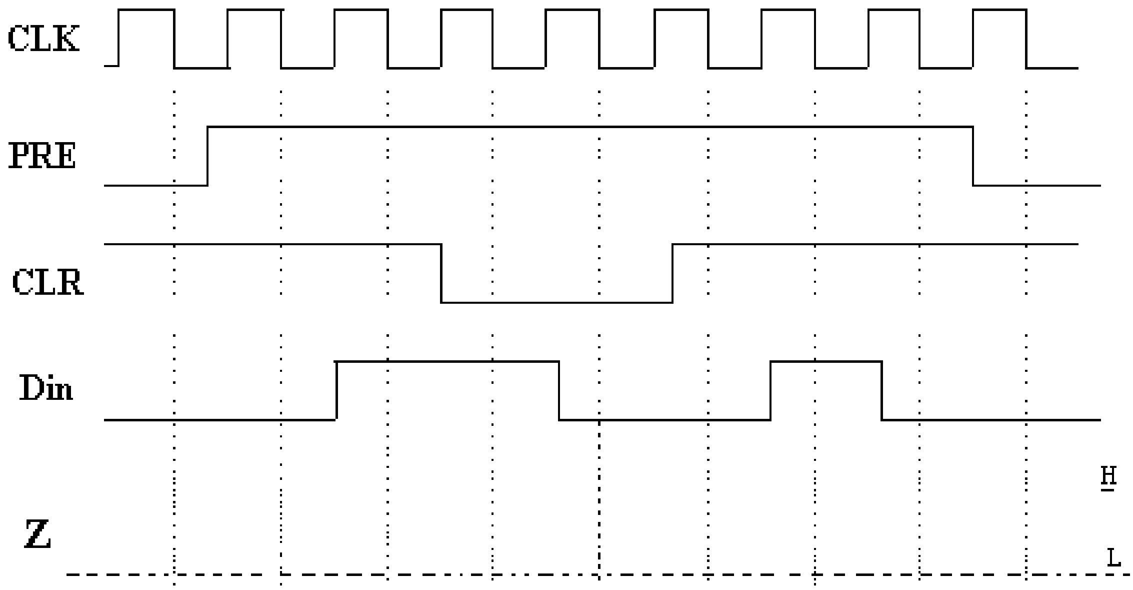


Figure B3



B4 A 3-input logic system has the following Boolean expression:

$$Y = ABC + \overline{A}B\overline{C} + \overline{A}BC + AB\overline{C} + A\overline{B}\overline{C}$$

(a) Complete the truth table of this logic system using a table format as shown in Table B4.

(5 marks)

Inputs			**Output**
A	**B**	**C**	**Y**
0	**0**	**0**	**?**
:	**:**	**:**	**:**
1	**1**	**1**	**?**

Table B4

(b) Using Boolean theorems or the K-map, reduce Boolean expression to its simplified form. Hence implement the logic system using the minimum number of basic gates.

(5 marks)

B5 For the circuit shown in figure B5,

(a) What is the Boolean equation for the circuit?

(b) Simplify the equation obtained in part (a) above.

(c) Determine the output level of X if A = 1, B = 1, C = 0, D = 1

(10 marks)

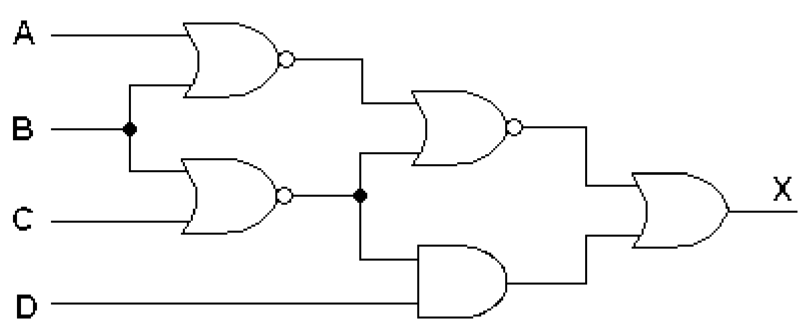


Figure B5

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B6 For the logic circuit in figure B6, draw the signal waveforms at outputs A, B and C in response to the input waveforms shown. You are to assume all propagation delays are negligible. The initial values at the outputs of the flip-flops are logic ‘0’. Enter your answers on the question paper. Write your admission number in the box provided.

(10 marks)

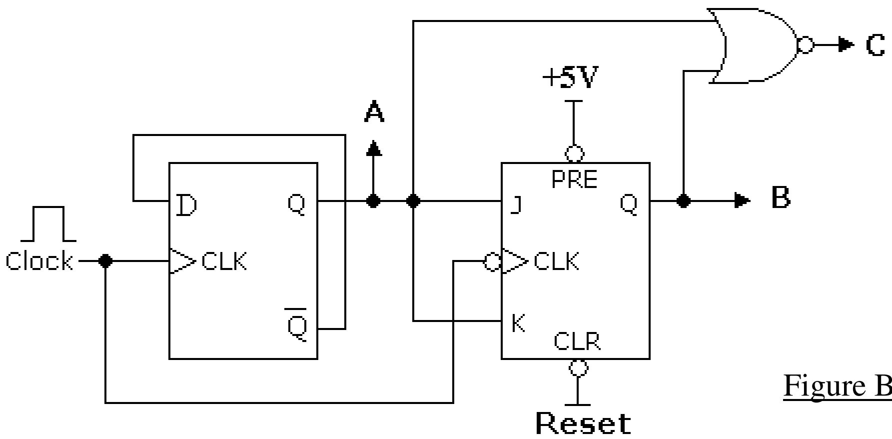
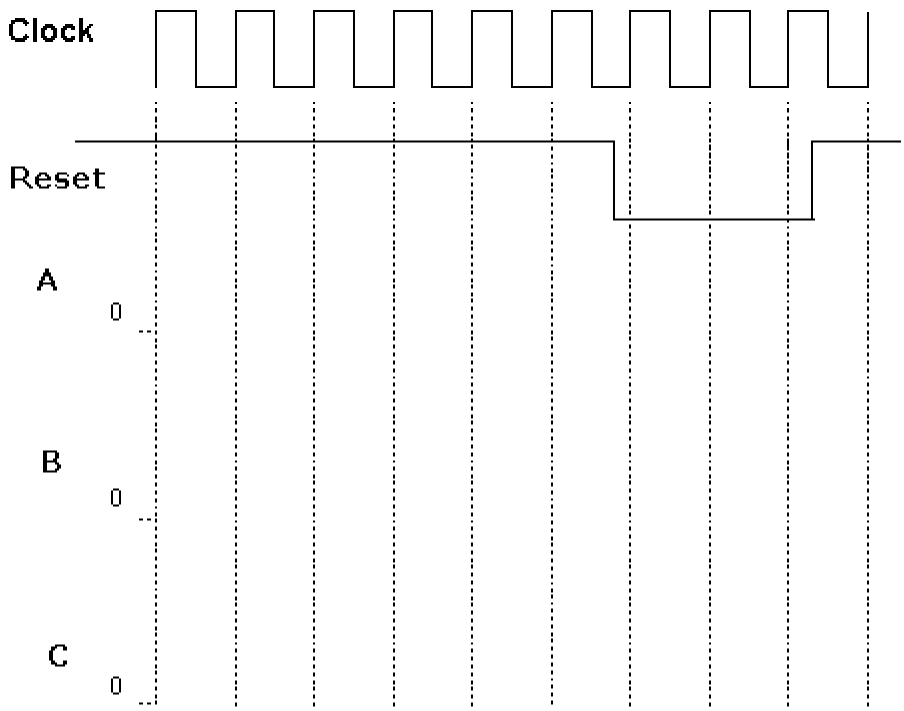


Figure B6



Section C Long Question (20 marks)

C1 The block diagram of a 2-bit Code Generator is given in figure C1 below.

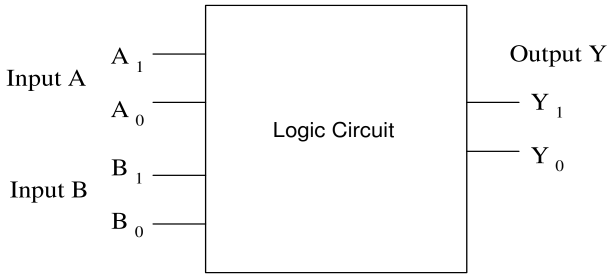


Figure C1

The circuit compares the logic levels of the 2-bit numbers, A and B, to produce output Y, where:

$Y_1 = 0$ and $Y_0 = 1$, whenever the number A > number B.
$Y_1 = B_1$ and $Y_0 = B_0$, whenever the number A < number B.
$Y_1 = Y_0 = 0$, whenever the number A = number B.

You are required to carry out the logic circuit design in the following steps:

(a) Determine the truth table for outputs Y_1 and Y_0. (10 marks)

Inputs				**Outputs**	
Number A		**Number B**		**Number Y**	
A_1	**A_0**	**B_1**	**B_0**	**Y_1**	**Y_0**
0	0	0	0	0	0
0	0	0	1	0	1
0	0	1	0		
0	0	1	1		
0	1	0	0		
0	1	0	1		
0	1	1	0		
0	1	1	1	1	1
1	0	0	0	0	1
1	0	0	1		
1	0	1	0		
1	0	1	1		
1	1	0	0		
1	1	0	1		
1	1	1	0	0	1
1	1	1	1	0	0

(b) Using the Kanaugh map, obtain the simplified Boolean expression for outputs Y1 and Y2.

(12 marks)

	$\overline{B}_1\overline{B}_0$	$\overline{B}_1 B_0$	$B_1 B_0$	$B_1\overline{B}_0$
$\overline{A}_1\overline{A}_0$				
$\overline{A}_1 A_0$				
$A_1 A_0$				
$A_1\overline{A}_0$				

Y_1 =

	$\overline{B}_1\overline{B}_0$	$\overline{B}_1 B_0$	$B_1 B_0$	$B_1\overline{B}_0$
$\overline{A}_1\overline{A}_0$				
$\overline{A}_1 A_0$				
$A_1 A_0$				
$A_1\overline{A}_0$				

Y_0 =

(c) Implement the simplified output Y_1 obtained in part (b) using ONLY NAND gates.

(3 marks)

------------- End of Paper ------------