Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2015/2016

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|---|---|---|
| COURSE NAME | : | DIGITAL ELECTRONICS |
| COURSE CODE | : | DAE 21203 |
| PROGRAMME | : | 1 DAE |
| EXAMINATION DATE | : | JUNE / JULY 2016 |
| DURATION | : | 2 HOURS 30 MINUTES |
| INSTRUCTION | : | ANSWER **FOUR (4)** QUESTIONS ONLY |

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

**Q1** (a) The compact disk (CD) player is an example of a system in which both digital and analog circuits are used. Draw and label clearly the block diagram that represents the basic principles of a CD player.

(5 marks)

(b) Explain **four (4)** advantages of digital techniques.

(4 marks)

(c) For the timing diagram in **Figure Q1(c)**:

(i) Determine the number of cycles displayed of waveform a, b and c.

(3 marks)

(ii) For the input signal of a, b and c, find the period, frequency and duty cycle

(6 marks)

(iii) Build the truth table for the timing diagram showing all inputs and output, a, b, c and F.

(4 marks)

(d) A pulse waveform with a frequency of 50 kHz is applied to the input of a counter. Determine how many pulses are counted during 100 ms.

(3 marks)

**Q2** (a) Convert hexadecimal number $A3_{hex}$ to:

(i) Binary number system.
(ii) Decimal number system.
(iii) BCD code
(iv) Gray code

(8 marks)

(b) Given the Boolean expression

$$Z = \overline{\overline{PQ} \cdot (RS + \overline{P}\,\overline{S}) \cdot (\overline{PQ} + \overline{RS})}$$

(i) Design the logic circuit from the Boolean equation.

(5 marks)

(ii) Simplify expression $Z$ using Boolean theorem.

(5 marks)

(iii) Implement the function $Z$ in **Q2 (b) (ii)** using only a 2-input NAND gates.

(7 marks)

**Q3.** (a) **Figure Q3 (a)** shows a combinational logic circuit designed to control the operation of a conveyor belt in Factory X.

(i) Simplify the Boolean expression for output Y from this combinational logic circuit.

(7 marks)

(ii) Draw the logic circuit from the simplified expression in **Q3(a)(i).**

(3 marks)

(b) By using Boolean theorem, prove the following Boolean expressions:

$$\overline{\overline{(A.\overline{B}.A)}.\overline{(A.\overline{B}.B)}} = A \oplus B$$

(5 marks)

(c) For the circuit in **Figure Q3(c)**

(i) Build the truth table

(ii) Write the Boolean expression for the output

(10 marks)

**Q4** (a) Find the simple expression for the output Z base on the truth table below

| W | X | Y | Z |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

(4 marks)

(b) For the following function:

$$F(W, X, Y, Z) = \sum(0,5,7,8,10,13,14,15) + d(2,3,4)$$

(i) Build the truth table

(4 marks)

(ii) Simplify using a Karnaugh map

(4 marks)

(iii) Obtain the minimum sum of product (SOP) expression

(2 marks)

(iv) Implement the simplified expression using basic logic gates

(3 marks)

(c) A combinational logic circuit which has one output Z and four (4) inputs (A,B,C,D) representing binary number. Output Z should be **HIGH (1)** if the input is at least 5 but not greater than 11.

(i) Build the truth table

(4 marks)

(ii) Write the minterm expression for the Z

(2 marks)

(iii) Write the maxterm expression for the Z

(2 marks)

**Q5.** (a) Solve the following arithmatics operations. Check the answer with its Decimal equivalent.

(i) $101_2 + 100_2$
(ii) $110_2 - 101_2$
(iii) $1001_2$ X $1011_2$
(iv) $+18_{10} - 25_{10}$ using 2's complement

(9 marks)

(b) A word length is 6 bits ( including sign bit ), change the binary number into decimal in 2's complement.

(i) $100001_2$
(ii) $010001_2$

(6 marks)

(c) A full adder has there (3) inputs A, B and $C_{in}$ and two ( 2 ) outputs SUM and $C_{out}$.

(i) Produce the truth table for the full adder.
(ii) Write the minimum SUM expressin by using Boolean Algebra.
(iii) Write the minimum $C_{out}$ expression by using Karnaugh map.

(10 marks)

**Q6.** (a) Consider a half adder :

(i) Draw the logic symbol
(ii) Build the truth table showing all the inputs and outputs ( SUM and $C_{out}$ )
(iii) Write the expression for both outputs

(6 marks)

(b) With the aids of diagrams, describe the function of the following device ;

(i) A decoder
(ii) A encoder

(6 marks)

(c) **Figure Q6(c)** is a logic symbol for the 4 bit 7483 parallel adder . Find the sum S and carry output $C_{out}$ for the addition below( assume $C_{in}$ is 0 ):

(i) A1A2A3A4 = 1010 and B1B2B3B4 = 1101
(ii) A1A2A3A4 = 1110 and B1B2B3B4 = 0111

(6 marks)

(d) Design an 8-1 multiplexer using:

(i) 4-1 multiplexers
(ii) Implement expression $F(X, Y, Z) = \sum m(0,1,4,7)$
(iii) implement expression $F(X, Y, Z) = \Pi m(0, 2, 5, 6)$

(7 marks)

**- END OF QUESTIONS –**

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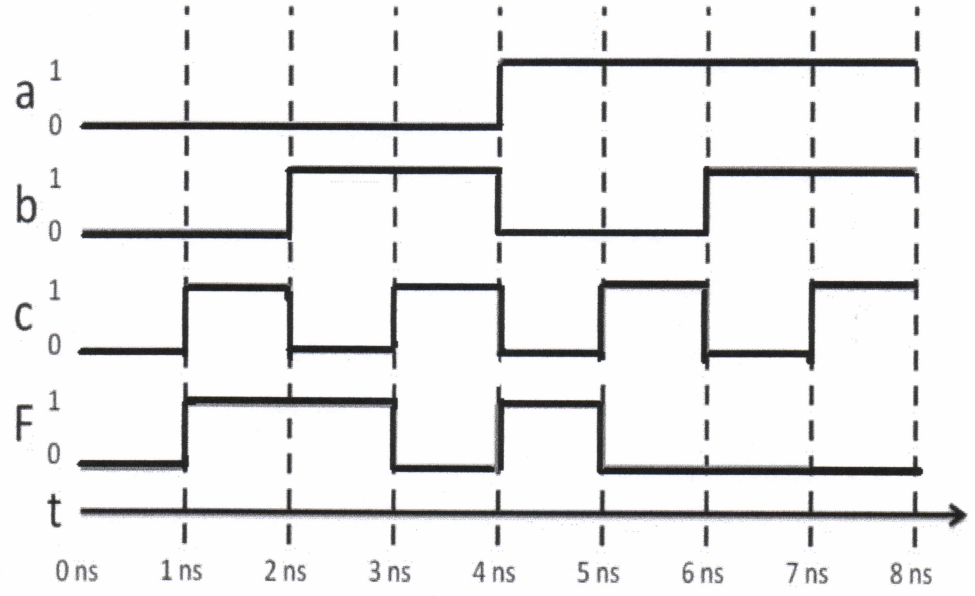


**FIGURE Q1(c)**

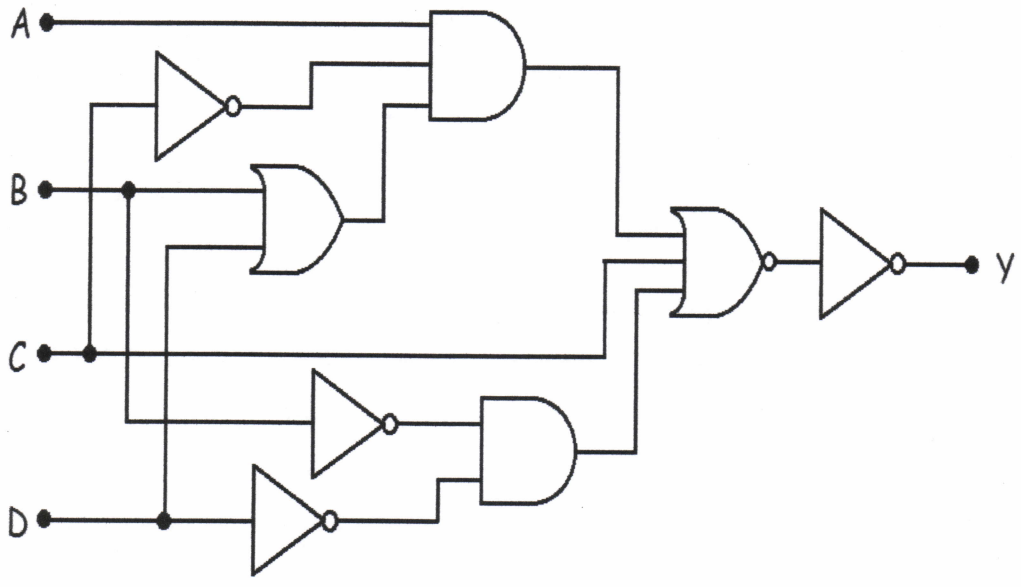


**FIGURE Q3(a)**

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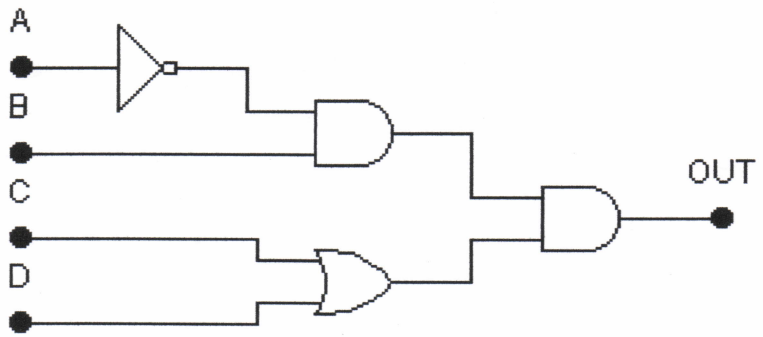


**FIGURE Q3(c)**

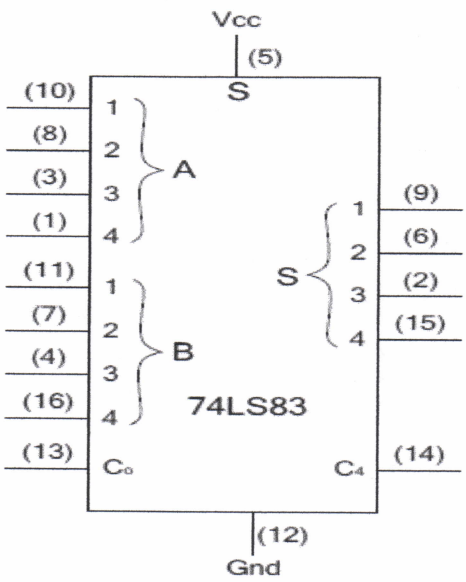


**FIGURE Q6(c)**