Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	DIGITAL ELECTRONICS
COURSE CODE	:	DAR 21303
PROGRAMME	:	2 DAR
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	2 ½ HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) Perform the following arithmatic operations. Check the answer with its decimal equivalent.

(i) $1101_2 + 0101_2 + 1011_2$
(ii) $10011010_2 + 00101011_2$
(iii) $+ 26_{10} - 35_{10}$ using 2's complement

(7 marks)

(b) A full adder has three (3) inputs: A, B and C_{in} and two (2) outputs: SUM and C_{out}.

(i) Produce a truth table for the full adder.
(ii) Obtain the minimum Boolean expression for SUM by using Boolean algebra rules and Karnaugh map for C_{out}.
(iii) Draw the simplified circuit for the full adder.

(15 marks)

(c) Convert 285_{10} to hexadecimal.

(3 marks)

Q2 (a) Explain the importance of Boolean theorems in digital systems and write four (4) examples of Boolean algebra rules.

(4 marks)

(b) Simplify the following Boolean expression using Boolean algebra and verify the result using a Karnaugh map.

$$Z = AB + A\bar{B}C + AB\bar{C}$$

(7 marks)

(c) The logic circuit in **Figure Q2(c)** has inputs A, B, C.

(i) Write the expression for the outputs X, Y and F.
(ii) Build a truth table for the logic circuit.
(iii) Sketch the timing diagram for waveforms at X, Y and F if the inputs *A, B* and C are as shown in **Figure Q2(c)(iii)**.

(14 marks)

Q3 (a) For the following Boolean expressions:

(i) Obtain the minimum sum of product (SOP) expression by using a Karnaugh map.

(ii) Implement the simplified expression using basic logic gates.

$$f(A,B,C,D) = \sum m\ (0,2,7,8,9) + d(4,5,10,14)$$

(9 marks)

(b) An automobile has digital sensors with the following logic states:
Key: 0 – Not in ignition, 1 – In ignition
Door: 0 – Open, 1 – Closed
Lights: 0 – OFF, 1 – ON.
An alarm signal will sound the buzzer for the following conditions:

- The key is in the ignition and the door is open
- The key is not in the ignition and the lights are on

Design this automobile alarm system.

(i) Obtain the truth table of the circuit.
(ii) Simplify the output function.
(iii) Draw the simplified logic diagram of this circuit using NAND gates only.

(16 marks)

Q4 (a) Briefly describe the difference between a decoder and an encoder.

(4 marks)

(b) A 2-input Multiplexer circuit whose output (Y) is equivalent to one of two possible data inputs (A or B). A control input (S) selects either the data on A input (if S is low) or data on the B input (if S is high) to be routed to the output (Y) line. Do the following:

(i) Draw the block diagram of this multiplexer circuit showing all inputs and output.
(ii) Build the truth table and write the Boolean expression for the output function.
(iii) Simplify the output function using K-map and implement the simplified function using NAND gates only.

(11 marks)

(c) Use the 74138 IC in **Figure Q4(d)** to implement the following fucntion:

(i) $F(A,B,C) = AB + C$

(ii) $W(X,Y,Z) = \overline{X}\,\overline{Y} + \overline{Y}Z + XY\overline{Z}$

(10 marks)

Q5 (a) **Figure Q5(a)(i)** shows a clocked RS flip flop and Figure **Q5(a)(ii)** shows waveforms applied to the circuit:

(i) Construct the truth table
(ii) Draw the output waveform Q.

(6 marks)

(b) Show how to create the following flip-flops from JK flip-flop:

(i) D flip-flop
(ii) T flip-flop

(4 marks)

(c) State TWO(2) differences between synchronous and asynchronous counters.

(4 marks)

(d) For the counter circuit in **Figure Q5(d)**

(i) Draw the timing diagram for the 4-bit counter.
(ii) Determine its counting sequence.
(iii) Determine the frequency of each output (A,B,C,D) if the clock frequency is 1 kHz.
(iv) Explain its operation.

(11 marks)

Q6 (a) The 4-bit serial input register in **Figure Q6(a)** has 1101 (Q,R,S,T) stored in it and data inputs are low. Show the register operations for four clock transitions by doing the following:

(i) Draw a table showing the state sequence
(ii) Draw the timing diagram.

(10 marks)

(b) Briefly explain two (2) essential differences between analog and digital signals.

(3 marks)

(c) Two conversions are necessary to interface real world, analog signals with a digital circuit. Name dan describe briefly the function of the two circuits used.

(4 marks)

(d) The circuit in **Figure Q6(d)(i)** is used in digital and analog interface. What

is the purpose of this circuit? Determine the output V_{out} and record its value in **Table Q6(d)** if the waveform representing a sequence of 4-bit numbers (D_3 D_2 D_1 D_0) in **Figure Q6(d)(ii)** is applied to the inputs.

(8 marks)

- END OF QUESTION -

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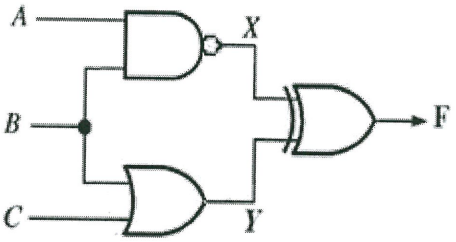

FIGURE Q2(c)

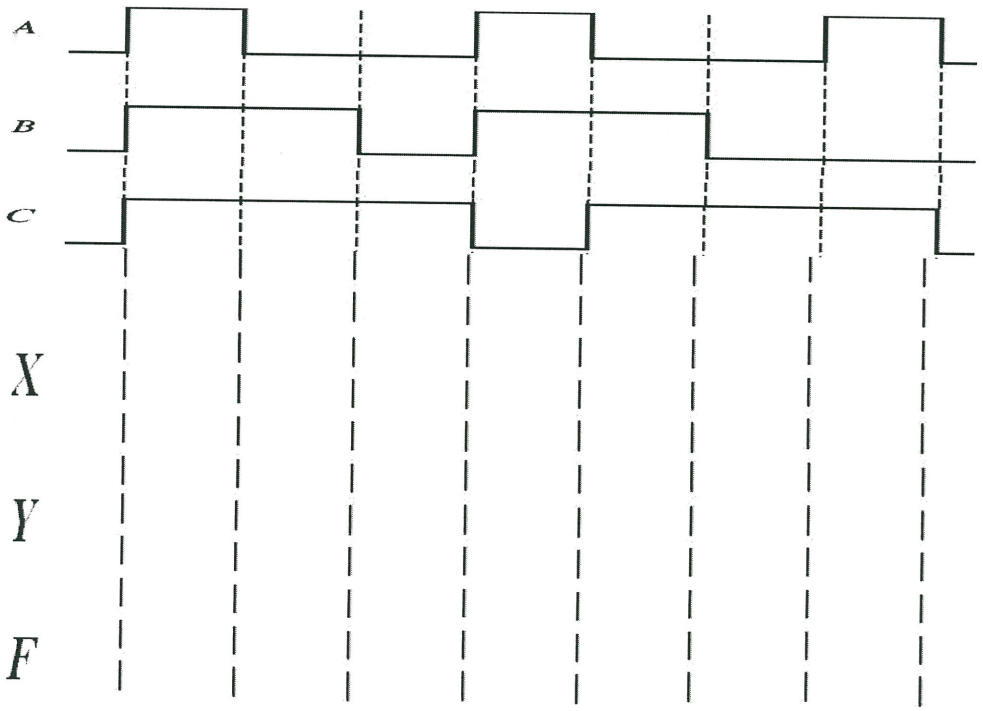

FIGURE Q2(c)(iii)

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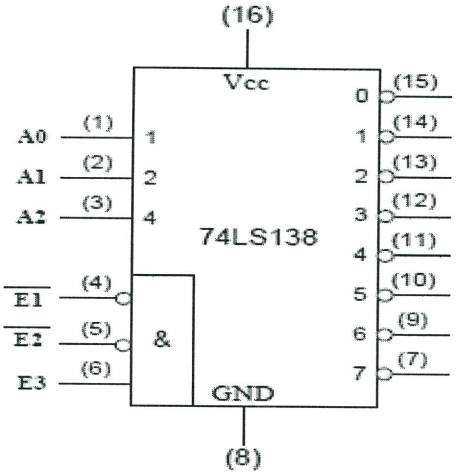

FIGURE Q4(d)

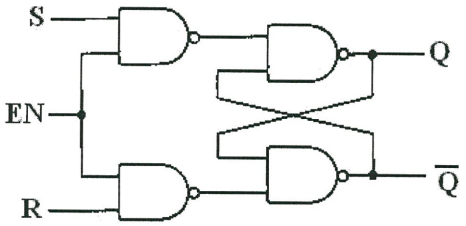

FIGURE Q5(a)(i)

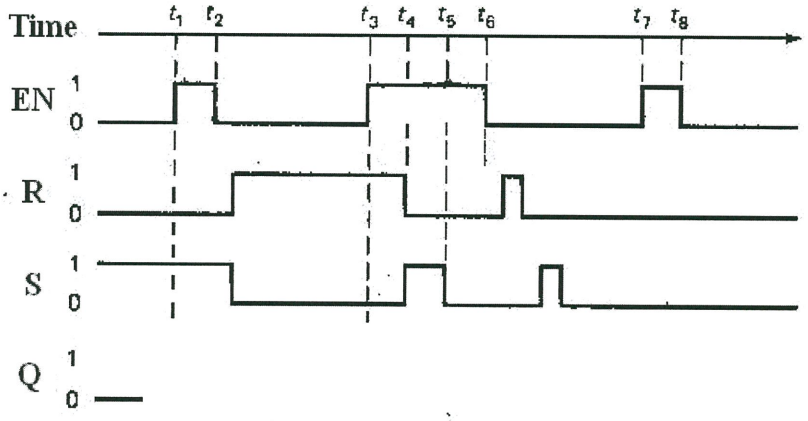

FIGURE Q5(a)(ii)

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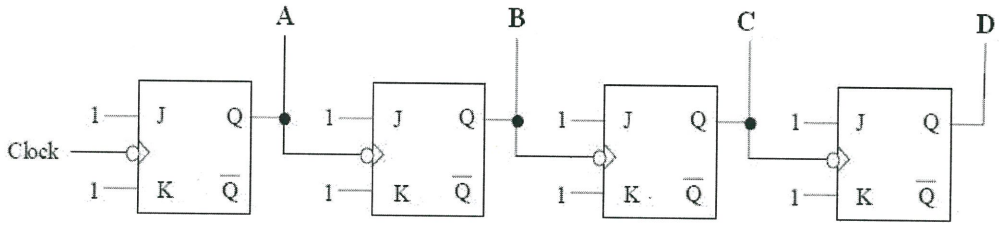

Timing diagram

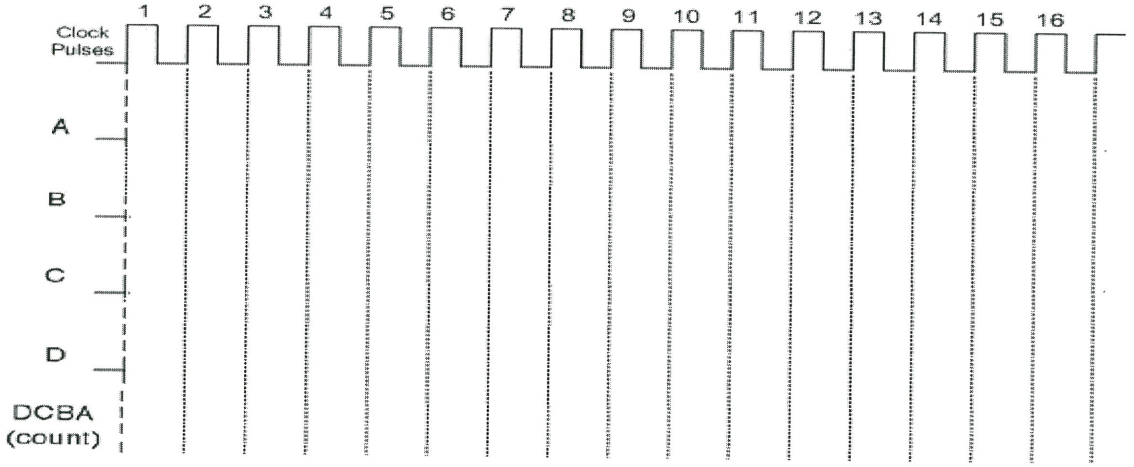

FIGURE Q5(d)

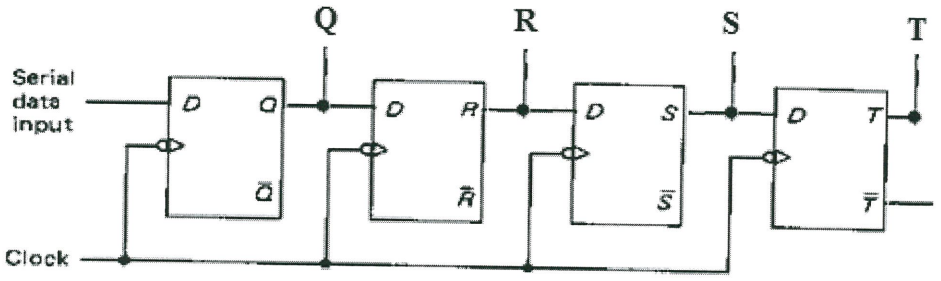

FIGURE Q6(a)

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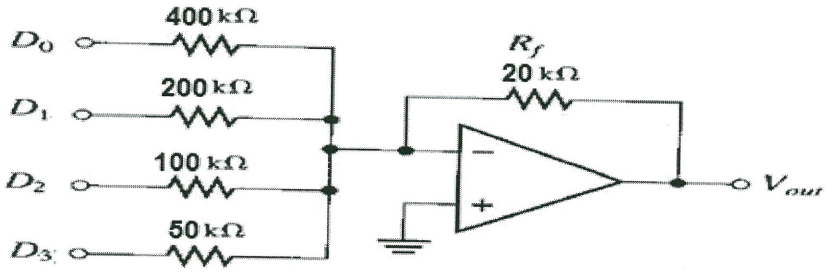

FIGURE Q6(d)(i)

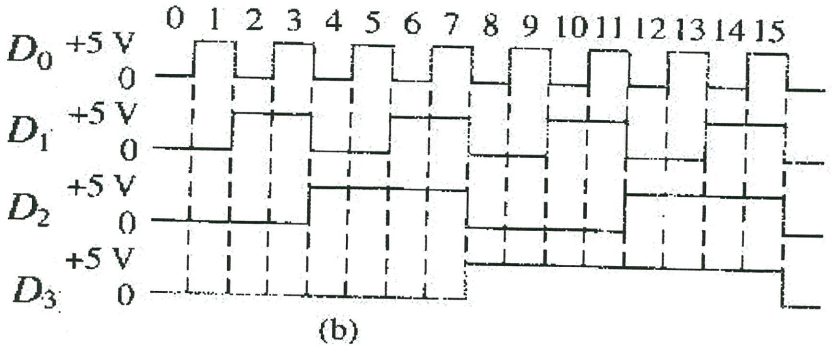

FIGURE Q6(d)(ii)

Table Q6

D_3	D_2	D_1	D_0	V_{out} (V)
0	0	0	0	
0	0	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	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	