



UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DMT 2063
COURSE	: DIGITAL SYSTEM
SEMESTER/SESSION	: 1-2023/2024
DURATION	: 3 HOURS

Instructions:

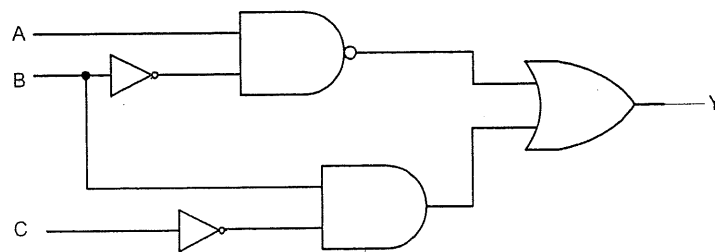
1. This booklet contains **4** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise up your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

- a) Signal carrying information can be divided into two broad categories which are digital and analog. Answer the followings question.
- i. Define analog and digital signal. (2 marks)
 - ii. Draw the waveform of analog and digital signal. (2 marks)
- b) List **TWO (2)** types of number system used in digital signal. (2 marks)
- c) Convert the following number systems to hexadecimal number. Write your answers up to two decimal places and shows the working method.
- i. 198.33_{10} (4 marks)
 - ii. 1001010.11001_2 (4 marks)
- d) Convert 147.3_{10} to binary coded decimal (BCD) number. Shows the working method. (4 marks)
- e) Based on Figure 1, answer the following questions, produce the:
- i. Boolean expression for output Y. (3 marks)
 - ii. Truth table for the logic circuit. (4 marks)

**Figure 1**

QUESTION 2

a) Answer the following questions:

- i. Draw the logic symbol for AND gate. (1 mark)
- ii. Produce the truth table for AND gate. (2 marks)

b) A logic circuit has three inputs, A, B and C. The output will be HIGH only when a majority of the inputs are HIGH. Answer the following questions.

- i. Produce the truth table. (2 marks)
- ii. Produce the standard sum-of-products (SOP) expression. (4 marks)
- iii. Draw the logic circuit. (4 marks)

c) For the Boolean expression below.

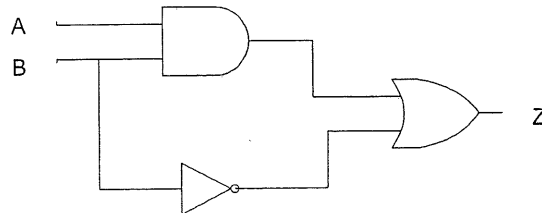
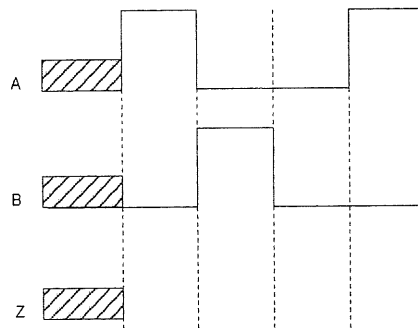
$$X(D, E, F, G) = DF + \bar{D}EFG + D\bar{E}F + \bar{E}FG$$

- i. Produce the standard sum-of-products (SOP) expression for output X. (4 marks)
- ii. Produce the simplified output expression X using K-Map. (5 marks)
- iii. Draw the logic circuit for the simplified Boolean expression obtained in 2c(ii). (3 marks)

QUESTION 3

- a) Refer to Figure 2. Complete the output timing diagram, Z in Figure 3 with A and B as the input signal. (Answer this question in the given answer booklet)

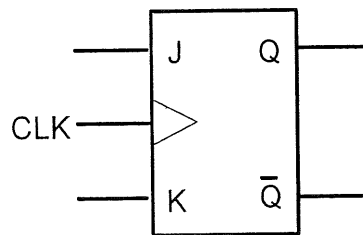
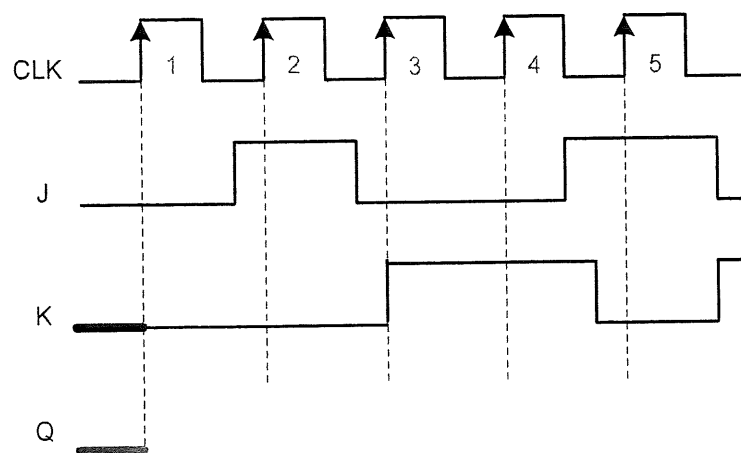
(4 marks)

**Figure 2****Figure 3**

- b) Implement the Boolean expression of $F(A,B,C) = \sum m(0,2,5,6)$ using 4-to-1 multiplexer. (6 marks)
- c) A system has three inputs A, B, and C. This system will produce HIGH output Y, only if the inputs (A, B, C) are less than two or greater than six.
- Produce the truth table for the given condition. (4 marks)
 - Produce the standard SOP expression from the truth table in question 3c(i). (3 marks)
 - Produce the simplified SOP expression using K-map (4 marks)
 - Draw the logic circuit based on the simplified Boolean expression obtained in question 3c(ii). (4 marks)

QUESTION 4

- a) List **THREE (3)** advantages of digital system (3 marks)
- b) Draw movement of data for parallel in serial out (PISO) shift register. (2 marks)
- c) List **TWO (2)** example of sequential circuit (2 marks)
- d) Figure 4 shows a logic symbol for JK Flip Flop. Complete the timing diagram in Figure 5 by drawing the output waveform of signal Q. (5 marks)

**Figure 4****Figure 5**

- e) A synchronous counter with a counting sequence as shown in Figure 6 is designed by using JK flip-flops. Assume all unused states are forced to don't care condition.
- Complete the excitation table in Table 1. (4 marks)
 - Produce the simplified Boolean equation for J_A , K_A , J_B , K_B , J_C and K_C by using K-map. (6 marks)
 - Draw logic circuit based on the simplified Boolean expression obtained in question 4e(ii) using positive edge triggered JK flip-flop circuit with active high clock and other suitable logic gates. (3 marks)

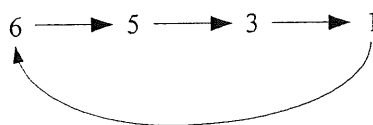


Figure 6

Table 1

PRESENT STATE			NEXT STATE			J_A	K_A	J_B	K_B	J_C	K_C
A	B	C	A'	B'	C'						
0	0	0									
0	0	1									
0	1	0									
0	1	1									
1	0	0									
1	0	1									
1	1	0									
1	1	1									

-----End of Question-----

APPENDIX 1

Table 1: Rules of Boolean Algebra

1. $A + 0 = A$	7. $A \cdot A = A$
2. $A + 1 = 1$	8. $A \cdot \bar{A} = 0$
3. $A \cdot 0 = 0$	9. $\bar{\bar{A}} = A$
4. $A \cdot 1 = A$	10. $A + AB = A$
5. $A + A = A$	11. $A + \bar{A}B = A + B$
6. $A + \bar{A} = 1$	12. $(A + B)(A + C) = A + BC$

Table 2: Excitation Table

Flip-Flop Name	Characteristic Table	Characteristic Equation	Excitation Table																																			
SR	<table><tr><th>S</th><th>R</th><th>Q_{n+1}</th></tr><tr><td>0</td><td>0</td><td>Q</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>Invalid</td></tr></table>	S	R	Q_{n+1}	0	0	Q	0	1	0	1	0	1	1	1	Invalid	$Q_{n+1} = S + \bar{R}Q$	<table><tr><th>Q_n</th><th>Q_{n+1}</th><th>S</th><th>R</th></tr><tr><td>0</td><td>0</td><td>0</td><td>X</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>X</td><td>0</td></tr></table>	Q_n	Q_{n+1}	S	R	0	0	0	X	0	1	1	0	1	0	0	1	1	1	X	0
S	R	Q_{n+1}																																				
0	0	Q																																				
0	1	0																																				
1	0	1																																				
1	1	Invalid																																				
Q_n	Q_{n+1}	S	R																																			
0	0	0	X																																			
0	1	1	0																																			
1	0	0	1																																			
1	1	X	0																																			
JK	<table><tr><th>J</th><th>K</th><th>Q_{n+1}</th></tr><tr><td>0</td><td>0</td><td>Q</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>$\bar{Q}$</td></tr></table>	J	K	Q_{n+1}	0	0	Q	0	1	0	1	0	1	1	1	$\bar{Q}$	$Q_{n+1} = J\bar{Q} + \bar{K}Q$	<table><tr><th>Q_n</th><th>Q_{n+1}</th><th>J</th><th>K</th></tr><tr><td>0</td><td>0</td><td>0</td><td>X</td></tr><tr><td>0</td><td>1</td><td>1</td><td>X</td></tr><tr><td>1</td><td>0</td><td>X</td><td>1</td></tr><tr><td>1</td><td>1</td><td>X</td><td>0</td></tr></table>	Q_n	Q_{n+1}	J	K	0	0	0	X	0	1	1	X	1	0	X	1	1	1	X	0
J	K	Q_{n+1}																																				
0	0	Q																																				
0	1	0																																				
1	0	1																																				
1	1	$\bar{Q}$																																				
Q_n	Q_{n+1}	J	K																																			
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0	1	1	X																																			
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1	1	X	0																																			
D	<table><tr><th>D</th><th>Q_{n+1}</th></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td></tr></table>	D	Q_{n+1}	0	0	1	1	$Q_{n+1} = D$	<table><tr><th>Q_n</th><th>Q_{n+1}</th><th>D</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table>	Q_n	Q_{n+1}	D	0	0	0	0	1	1	1	0	0	1	1	1														
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T	<table><tr><th>T</th><th>Q_{n+1}</th></tr><tr><td>0</td><td>Q</td></tr><tr><td>1</td><td>$\bar{Q}$</td></tr></table>	T	Q_{n+1}	0	Q	1	$\bar{Q}$	$Q_{n+1} = T\bar{Q} + \bar{T}Q$	<table><tr><th>Q_n</th><th>Q_{n+1}</th><th>T</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table>	Q_n	Q_{n+1}	T	0	0	0	0	1	1	1	0	1	1	1	0														
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