College of Computer Science & Engineering at Yanbu.

جامعة طيبة
TAIBAH UNIVERSITY

كلية علوم وهندسة الحاسبات بينبع

Department of Computer Science.

قسم علوم الحاسبات

Final Exam

Academic Year 1447 - First Semester

Exam Information معلومات الامتحان			
Course name	**تصميم المنطق الرقمي**		**اسم المقرر**
Course Code	**COE 211**		**رمز المقرر**
Exam Date	5 / 1 / 2025	**الاثنين**	**تاريخ الامتحان**
Exam Time	11:00 – 13:00		**وقت الامتحان**
Exam Duration	2 Hour		**مدة الامتحان**
Classroom No.	**GF 1**		**رقم قاعة الاختبار**
Instructor Name	**Prof. Dr. Mostafa Elhosseini**		**اسم استاذ المقرر**

Student Information معلومات الطالب		
Student's Name		**اسم الطالب**
ID number		**الرقم الجامعي**
Section No.		**رقم الشعبة**
Serial Number		**الرقم التسلسلي**

General Instructions:

تعليمات عامة:

- Your Exam consists of 3 PAGES (except this paper)
- Phones and smart devices are forbidden inside the hall.

- عدد صفحات الامتحان 3 صفحة. (بإستثناء هذه الورقة)
- يمنع استخدام الهواتف والأجهزة الذكية داخل القاعة.

هذا الجزء خاص بأستاذ المادة

#	Course Learning Outcomes (CLOs)	Related Question (s)	Points	Final Score
1	Write numbers in various number systems.	Q1 – Part A	2	
2	Recognize the basics of Boolean algebra.	Q1 – Part B	2	
3	Describe the basic concept of sequential circuit.	Q1 – Part C	6	
4	Analyze small- and medium-scale logic functions as building blocks.	Q2 – Part A	6	
5	Analyze and design the behavior of sequential circuits.	Q2 – Part B	8	
6	Simplify Boolean functions using Boolean algebra and the Karnaugh map.	Q1 – Part D	8	
7	Communicate effectively in oral and written form	Q3	8	

Question 1: Points: 18		CLO #1, 2,3,6

Part A: Points 2 **CLO #1**

1. What is the decimal equivalent of the binary number $\mathbf{101101_2}$?
   A) 41
   B) 43
   C) 45
   D) 47
2. Which of the following represents the hexadecimal equivalent of $\mathbf{1110_2}$?
   A) A
   B) C
   C) D
   D) E

Part B: Points 2 **CLO #2**

3. If $\boldsymbol{F = A(\bar{A} + B)}$ then the simplified form of F is:
   A) AB
   B) $A + B$
   C) B
   D) 0

4. Which expression is logically **equivalent** to $A \oplus B$(XOR)?

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

Part C: Points 6 **CLO #3**

5. Which of the following elements is essential in a sequential circuit but not in a combinational circuit?
   A) Logic gates
   B) Flip-flops
   C) Boolean expressions
   D) Multiplexers

6. For a **D flip-flop**, the next state is given by:

   A) $Q(t + 1) = D \oplus Q(t)$
   B) $Q(t + 1) = D$
   C) $Q(t + 1) = \bar{D}$
   D) $Q(t + 1) = D \cdot Q(t)$

7. For a JK flip-flop, when $J = K = 1$, the output:
   A) Remains unchanged
   B) Is reset to 0
   C) Is set to 1
   D) Toggles its current state
8. A flip-flop must change state from $Q(t) = 1 \rightarrow Q(t + 1) = 0$
   Which **JK inputs** can achieve this transition?
   A) J=X, K=0
   B) J=0, K=X
   C) J=1, K=X
   D) J=X, K=1
9. Which signal synchronizes state changes in synchronous sequential circuits?
   A) Enable
   B) Reset
   C) Clock
   D) Data
10. Which of the following is an example of a sequential circuit?
    A) Full adder
    B) Decoder
    C) Counter
    D) Multiplexer

Part D: Points 8 **CLO #6**

11. Simplify the Boolean expression: $\boldsymbol{A + A \cdot B}$
    A) A
    B) B
    C) A + B
    D) AB
12. Using De Morgan's theorem, the **complement** of $\boldsymbol{A + B}$ is:
    A) $\bar{A} + \bar{B}$
    B) AB
    C) $\bar{A}\bar{B}$
    D) $A\bar{B}$
13. How many cells are there in a 3-variable Karnaugh map?
    A) 4
    B) 6
    C) 8
    D) 16
14. Simplify the expression: $AB + A\bar{B}$
    A) B
    B) A

C) $A + B$
D) $\bar{A}$

15. The simplified form of $\boldsymbol{A\bar{B} + AB}$ is:
A) A
A) B
B) $\bar{A}$
C) $A + B$

16. Simplifying the Boolean function: $\boldsymbol{F = AB + \bar{A}B + AB\bar{C}}$ using Karnaugh map gives

A) AB
B) B
C) $A + B$
D) BC

17. What is the **minimal SOP expression** for $F(A, B, C) = \sum m(1,3,5,7)$

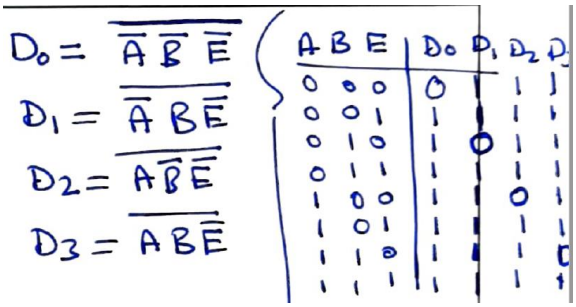
A) C
B) AB
C) $A + C$
D) $B + C$

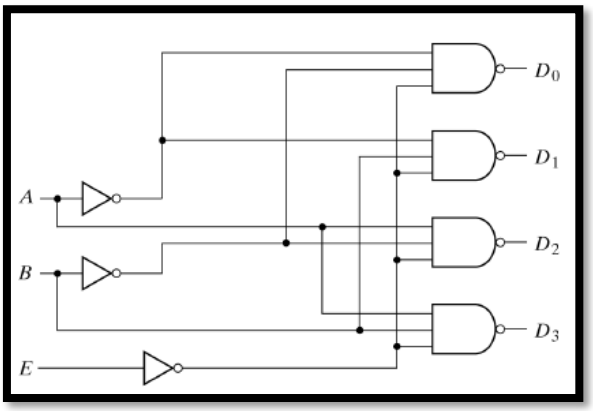
18. The Boolean function is defined as: $F(A, B, C) = \sum m(0, 2, 3, 6, 7)$ What is the **minimal SOP expression** for F?
A) $B + \bar{A}\bar{C}$
B) $A + B$
C) $B + \bar{A}$
D) $AB + \bar{A}C$

Question 2: Points: 14		**CLO #4,5**

Part A: Points 6 **CLO #4**

For the logic circuit shown below, write down the Boolean equations for outputs and then Construct the truth table



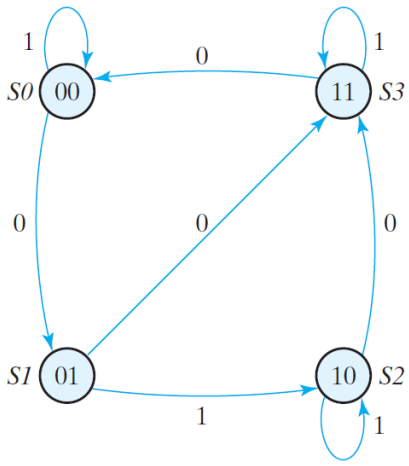


Part B: Points 8 **CLO #5**

For the state table shown below, a synchronous sequential circuit is implemented using **two JK flip-flops**, where flip-flop **A** stores the state variable *A*and flip-flop **B** stores the state variable *B*;

A. Using the **JK excitation table**, determine and fill in the required flip-flop inputs
B. Use the completed table to **draw the corresponding state diagram**

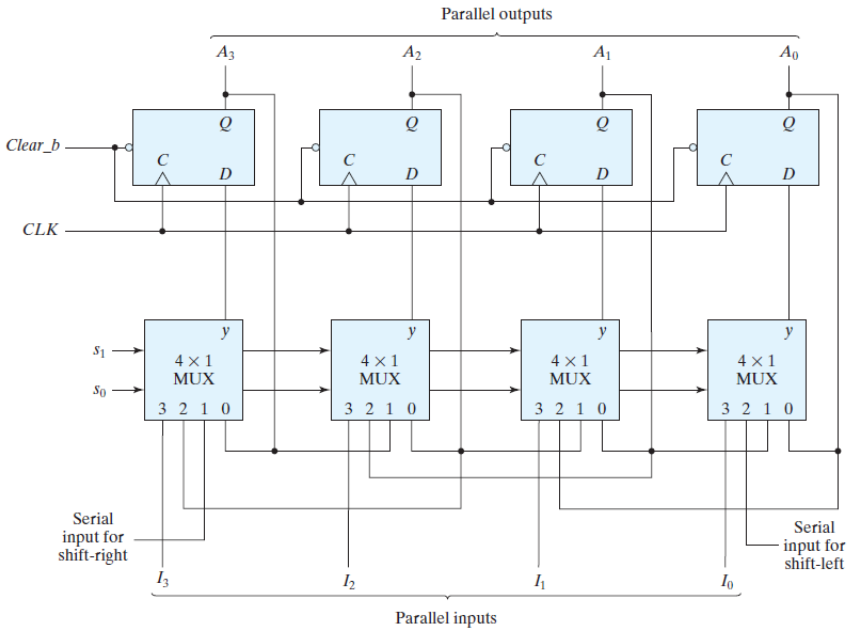
Present State		Input	Next State		Flip-Flop Inputs			
A	B	x	A	B	J_A	K_A	J_B	K_B
0	0	0	0	1				
0	0	1	0	0				
0	1	0	1	1				
0	1	1	1	0				
1	0	0	1	1				
1	0	1	1	0				
1	1	0	0	0				
1	1	1	1	1				



Present State		Input	Next State		Flip-Flop Inputs			
A	B	x	A	B	J_A	K_A	J_B	K_B
0	0	0	0	1	0	0	1	0
0	0	1	0	0	0	0	0	1
0	1	0	1	1	1	1	1	0
0	1	1	1	0	1	0	0	1
1	0	0	1	1	0	0	1	1
1	0	1	1	0	0	0	0	0
1	1	0	0	0	1	1	1	1
1	1	1	1	1	1	0	0	0

Question 3: Points: 8		**CLO #7**

Describe the **functions** performed by this shift register, clearly explaining each mode of operation (such as holding data, shifting left, shifting right, and parallel loading).



Name
ID
Class
ZIPGRADE.COM
Elhosseini18 (1489)
1 A B C D 10 A B C D
2 A B C D 11 A B C D
3 A B C D 12 A B C D
4 A B C D 13 A B C D
5 A B C D 14 A B C D
6 A B C D 15 A B C D
7 A B C D 16 A B C D
8 A B C D 17 A B C D
9 A B C D 18 A B C D