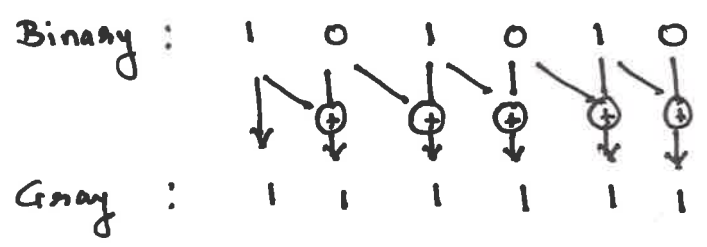


Q1 a) 1.

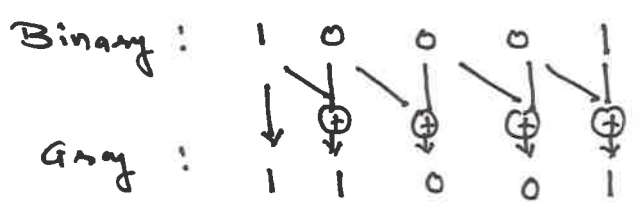
$(42)_{10} = (101010)_2$



$(42)_{10} = (111111)_{Gray}$

----- 2½ marks

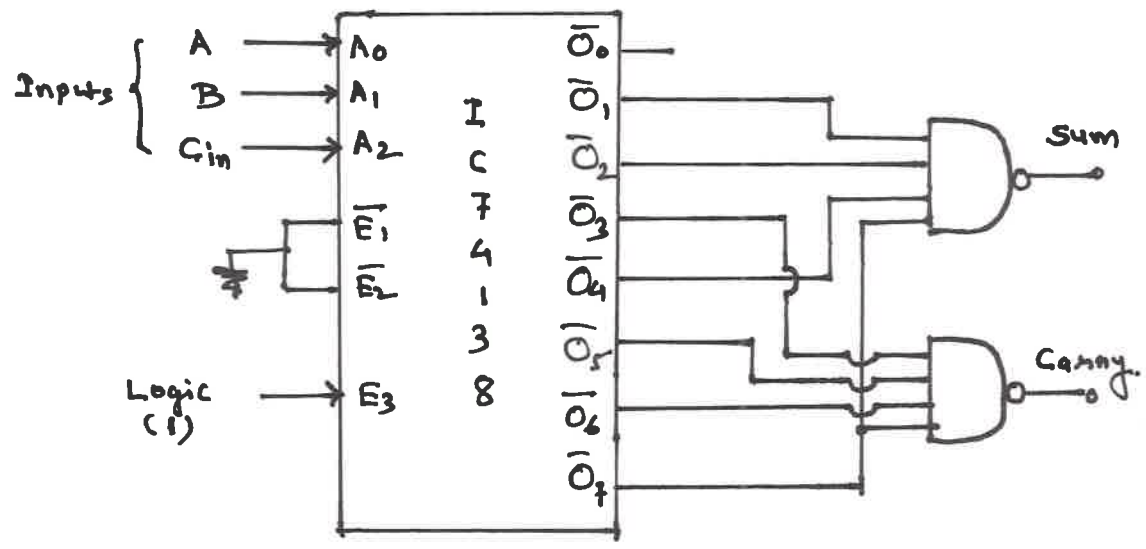
2. $(17)_{10} = (10001)_2$



$(17)_{10} = (11001)_{Gray}$

----- 2½ marks.

c) Full adder using IC74138



Q1 d)

Step 1) Write the truth table for conversion. The required truth table is obtained from excitation table is obtained from excitation table of JK & T flip flop.

T	Inputs		Outputs	
	Present state Q_n	Next state Q_{n+1}	J	K
0	0	0	0	X
1	0	1	1	X
1	1	0	X	1
0	1	1	X	0

← Excitation Table of TFF →

← Excitation Table of JK FF →

Step 2) K Map and simplification.

--- 2 marks

	Q_n	
T	0	1
0	0	X
1	1	X

J output

$$J = T$$

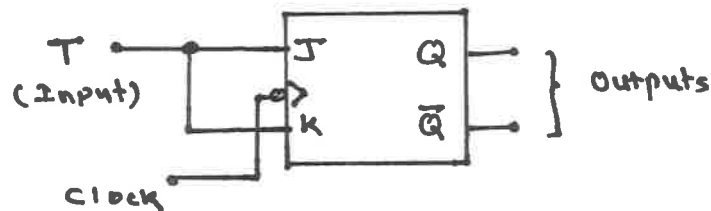
	Q_n	
T	0	1
0	X	0
1	X	1

K output

$$K = T$$

Step 3: Logic Diagram

--- 2 marks



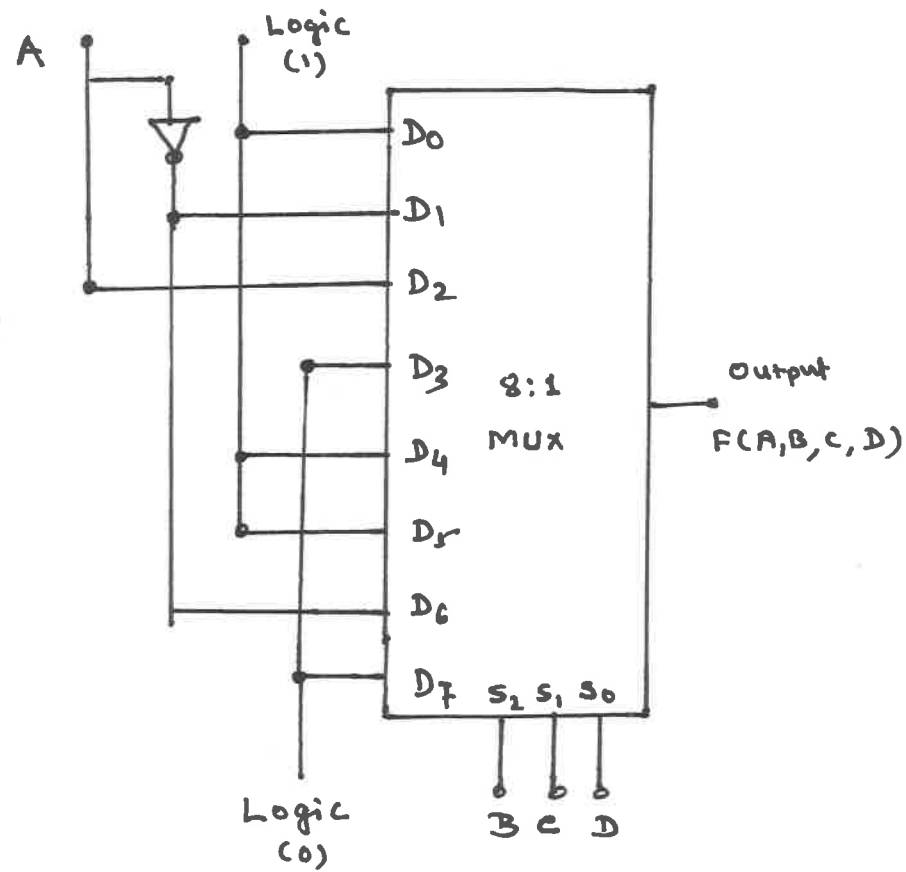
--- 1 mark.

Q 2 b)

$$F(A, B, C, D) = \sum m(0, 1, 4, 5, 6, 8, 10, 12, 13)$$

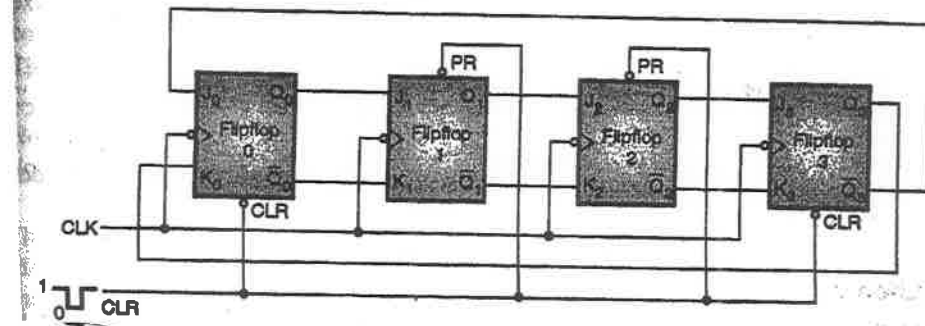
Design Table:

Inputs	D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	D ₆	D ₇
\bar{A}	0	1	2	3	4	5	6	7
A	8	9	10	11	12	13	14	15
Input Mux	1	\bar{A}	A	0	1	1	\bar{A}	0



Q3 a) Johnson Counter :

Counters 0 and 3 are reset to 0 while counters 1 and 2 are preset to 1 initially.
 $\therefore Q_3 Q_2 Q_1 Q_0 = 0-110$



The other possible states of this Johnson's Counter are given below.

Clear	CLK	Q_3	Q_2	Q_1	Q_0
$\overline{0}$	X	0	1	1	0
1	\downarrow	1	1	0	1
1	\downarrow	1	0	1	0
1	\downarrow	0	1	0	0
1	\downarrow	1	0	0	1

Q 3 b)

Step 1) Group minterms --- number of 1's.

Group	Minterms	Binary Representation			
		A	B	C	D
0	0	0	0	0	0
1	1	0	0	0	1
	2	0	0	1	0
2	3	0	0	1	1
	5	0	1	0	0
	9	1	0	0	1
3	7	0	1	1	1
	11	1	0	1	1

Step 2) Form Pairs

Group	Minterm Pair	Binary Representation			
		A	B	C	D
0	0, 1	0	0	0	-
	0, 2	0	0	-	0
1	1, 3	0	0	-	1
	1, 5	0	-	0	1
	1, 9	1	0	0	1
	2, 3	0	0	1	-
2	3, 7	0	-	1	1
	3, 11	1	0	1	1
		0	1	-	1
		1	0	-	1

Step 3) Group of four

Group	Minterms Quads	Binary Representation			
		A	B	C	D
0	0, 1, 2, 3	0	0	-	-
	0, 2, 1, 3	0	0	-	-
1	1, 3, 5, 7	0	-	-	1
	1, 5, 3, 7	0	-	-	1
	1, 3, 9, 11	-	0	-	1
	1, 9, 3, 11	-	0	-	1

Step 4) Prime implicants

Prime Implicants	Decimal Number	Given Minterms							
		0	1	2	3	5	7	9	11
$\bar{A}\bar{B}C$	2, 3			X	X				
$\bar{B}CD$	3, 11				X				X
$\bar{A}\bar{B}$	0, 1, 2, 3	(X)	X	X	X				
$\bar{A}D$	1, 3, 5, 7		X		X	(X)	(X)		
$\bar{B}D$	1, 3, 9, 11		X		X			(X)	X

Step 5) K map. verification.

		CD				
AB		00	01	11	10	
00		1	1	1	1	$\bar{A}\bar{B}$
01		0	1	1	0	$\bar{A}D$
11		0	0	0	0	
10		0	1	1	0	$\bar{B}D$

$$F(A, B, C, D) = \bar{A}\bar{B} + \bar{A}D + \bar{B}D$$

Q4 b)

$$\begin{aligned} \rightarrow AB + BC + \bar{A}C &= AB + BC(A + \bar{A}) + \bar{A}C \quad \because A + \bar{A} = 1 \\ &= AB + ABC + \bar{A}BC + \bar{A}C \\ &= AB(1 + C) + \bar{A}C(1 + B) \\ \text{But } (1 + C) &= 1 \quad \text{and } (1 + B) = 1 \\ &= AB(1) + \bar{A}C(1) \\ &= AB + \bar{A}C \end{aligned}$$

$$\begin{aligned} 2) [(C + \bar{C}D)(C + \bar{C}\bar{D})] [A(B + \bar{B}) + \bar{A}(\bar{B} + B)] \\ &= [CC + C\bar{D} + C\bar{D} + D\bar{D}] [A(B + \bar{B}) + \bar{A}(\bar{B} + B)] \\ &= [C + C\bar{D} + C\bar{D} + 0] [A(1) + \bar{A}(1)] \\ &= C[1 + \bar{D} + D] [A + \bar{A}] \\ &= C(1)(1) \\ &= C \end{aligned}$$