



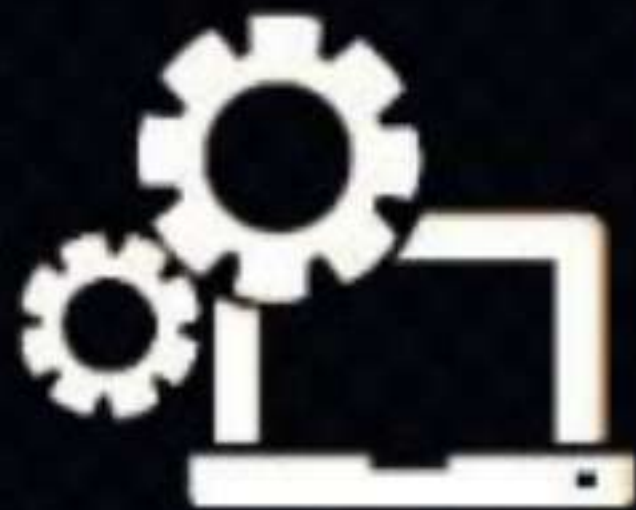
CS & IT ENGINEERING

DIGITAL LOGIC

MINIMIZATION

(IMPLICANTS & PRIME IMPLICANTS)

Lecture No. – 05



By- CHANDAN SIR

TOPICS TO BE COVERED

01 Prime Implicants

02 Essential Prime Implicants

03 Question Practice

03 Discussion

PRIME IMPLICANTS AND ESSENTIAL PRIME IMPLICANTS



✓ Implicant

✓ Prime Implicant

✓ Essential Prime Implicant

non EPI { Selective Prime Implicant (SPI)
Reduced Prime Implicant (RPI)

Q.1

$\text{EPI} = \{\bar{A}\bar{B}, AB\}$
 $\text{non EPI} = \{\bar{A}C, BC\}$

$$f(A, B, C) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}BC + AB\bar{C} + ABC = \sum m(0, 1, 3, 6, 7)$$

		$\xrightarrow{A \backslash BC}$			
		$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
\bar{A}	0	1	1	1	
A	1			1	1

		$\xrightarrow{A \backslash BC}$			
		BC 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
\bar{A}	0	1	1	1	
A	1			1	1

$\text{EPI} = \bar{A}\bar{B} + AB + \bar{A}C$

$\text{non EPI} = \bar{A}\bar{B} + AB + BC$

Implicant = 5

PI = 4

EPI = 2

SPI = 1

RPI = 1

Q.2

$$f(A, B, C) = \sum m(2, 3, 4, 5, 7)$$

$$PI = \{ \underbrace{\bar{A}B, A\bar{B}}_{EPI}, \underbrace{A.C, B.C}_{non\ EPI} \}$$

A \ BC	00	01	11	10
0			1	1
1	1	1	1	

A \ BC	00	01	11	10
0			1	1
1	1	1	1	

$$= \bar{A}B + A\bar{B} + A.C$$

$$= \bar{A}B + A\bar{B} + B.C$$

Implicant = 5

$$PI = 4$$

$$EPI = 2$$

$$SPI = 1$$

$$RPI = 1$$

Q.3

$$f(A, B, C) = \sum m(0, 1, 3, 4, 6, 7)$$

$$PI = \{ \bar{A}\bar{B}, BC, A\bar{C}, \bar{B}\bar{C}, \bar{A}C, AB \}$$

non EPI

$A \backslash BC$	00	01	11	10
0	1	1	1	0
1	1	0	1	1

$$= \bar{A}\bar{B} + BC + A\bar{C} \checkmark$$

$A \backslash BC$	00	01	11	10
0	1	1	1	0
1	1	0	1	1

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

$$I = 6$$

$$PI = 6$$

$$EPI =$$

$$SPI = 3$$

$$RPI = 3$$

Q.4

$$f(A, B, C) = \sum m(0, 2, 3, 4, 5, 7)$$

$$PI = \{ \bar{B}\bar{C}, AC, \bar{A}B, \bar{A}\bar{C}, A\bar{B}, BC \}$$

non EPI

A \ BC	00	01	11	10
0	1		1	1
1	1	1	1	

$$= \bar{B}\bar{C} + AC + \bar{A}B$$

A \ BC	00	01	11	10
0	1		1	1
1	1	1	1	

$$= \bar{A}\bar{C} + A\bar{B} + BC$$

$$I = 6$$

$$PI = 6$$

$$EPI = 0$$

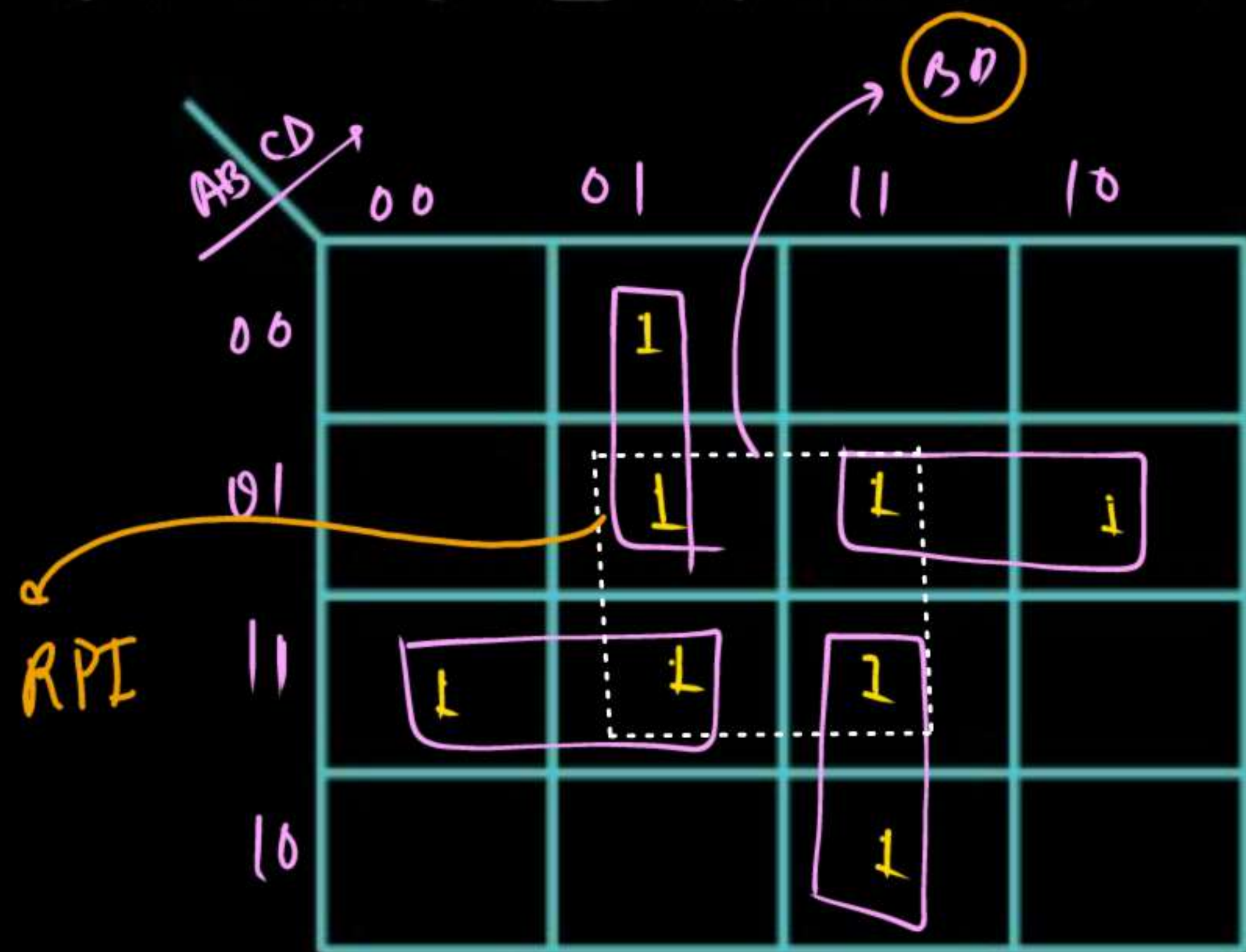
$$SPI = 3$$

$$RPI = 3$$

Q.5

$$PI = \{ \underbrace{\bar{A}\bar{C}D, \bar{A}BC, AB\bar{C}, ACD}_{EPI}, \underbrace{BD}_{\text{non EPI}} \}$$

$$f(A, B, C, D) = \sum m(1, 5, 6, 7, 11, 12, 13, 15)$$



$$I = 8$$

$$PI = 5$$

$$= \bar{A}\bar{C}D + \bar{A}BC + AB\bar{C} + ACD$$

$$EPI = 4$$

$$SPI = 0$$

$$RPI = 1$$

$$PI = \{ \underbrace{\bar{A}\bar{B}\bar{C}, A\bar{C}\bar{D}}_{EPI}, \underbrace{\bar{A}\bar{C}D, \bar{A}BD, BCD, ABC}_{non\ EPI} \}$$

ABCD

	00	01	11	10
00	1	1		
01		1	1	
11			1	1
10				1

$$= \underbrace{\bar{A}\bar{B}\bar{C} + A\bar{C}\bar{D}}_{EPI} + \bar{A}BD + ABC \quad I = 7$$

$$PI = 6$$

$$EPI = 2$$

$$SPI = 2$$

$$RPI = 2$$

Q.7

AB \ CD

	00	01	11	10
00	1	1		
01	1	1	1	1
11			1	1
10				

RPI

$$\Rightarrow \bar{A}\bar{C} + BC$$

$$I = 8$$

$$PI = 3$$

$$EPI = 2$$

$$SPI = 0$$

$$RPI = 1$$

Q.8

$$PI = \{ \underbrace{D, AB}_{EPI} \}$$

$$\text{no } EPI = 0 //$$

AB \ D	00	01	11	10
00		1	1	
01		1	1	
11	1	1	1	1
10		1	1	

$$= \bar{D} + AB$$

$$I = 10$$

$$PI = 2.$$

$$EPI = 2$$

$$SPI = 0$$

$$RPI = 0$$

Q.9

$$PI = \underbrace{\{\bar{B}\bar{D}, BD\}}_{EPI}, \underbrace{AD, A\bar{C}}_{\text{non EPI}}$$

AB \ CD	00	01	11	10
00	1			1
01		1	1	
11		1	1	
10	1	1	1	1

$\Rightarrow \underbrace{\bar{B}\bar{D} + BD}_{EPI} + AD$
 $\underbrace{\bar{B}\bar{D} + BD + A\bar{C}}_{SPI}$

$I = 10$
 $PI = 4$
 $EPI = 2$
 $SPI = 1$
 $RPI = 1$

		$B \rightarrow \begin{matrix} \overline{B}\overline{C} & \overline{B}C & B\overline{C} & BC \\ 00 & 01 & 11 & 10 \end{matrix}$			
\overline{A}	0	1	1	1	
A	1		1	1	1

$$= \overline{A}\overline{B} + AB + C$$

EPI

$$I = 6$$

$$PI = 3$$

$$EPI = 3$$

$$SPI = 0$$

$$RPI = 0$$

AB \ CD

	00	01	11	10
00	1			1
01		1	1	
11		1	1	
10	1	1	1	1

$$\Rightarrow \bar{B}\bar{D} + BD + AD$$

$$\Rightarrow \bar{B}\bar{D} + BD + A\bar{B}$$

$$\underline{EPI = 2}$$

PRIME IMPLICANTS AND ESSENTIAL PRIME IMPLICANTS

- i) **Implicants:** The total number of min-terms in the Boolean expression are called Implicants. Or in K-map the total number of 1 is called Implicants.
- ii) **Prime Implicants (PI):** The total number of min-terms in the Boolean expression are called Implicants. Or in K-map the total number of 1 is called Implicants.
- iii) **Essential PI/Selective PI:**
- iv) **Reduced PI:** The total number of min-terms in the Boolean expression are called Implicants. Or in K-map the total number of 1 is called Implicants.

Note: For an n -variables Boolean function, the maximum, number of prime implicants is $2^{(n-1)}$. A group of square or rectangle made up of bunch of adjacent min-terms which is allowed by definition of K-Map are called prime implicants(PI) i.e. all possible groups formed in K-Map.

Q.10

H/W.



Let a function F which has 3 input variables (x, y, z) . The function F will be high only when at least two of the input variables are set to high. Draw the K-Map for the given function. Let the number of PI in K-Map = 'a' and the number of EPI in K-Map = 'b'. Find the quadratic mean of 'a' and 'b' _____

A 3

B 4

C 5

D 6

Q.11



Find the number of Prime implicants & Essential prime implicants in the given K

- A** 3, 6
- B** 4, 0
- C** 5, 6
- D** 6, 6

		RS			
		PQ	00	01	11
PQ	00	1			
	01		1		1
	11	1			
	10		1		1

$$I = PI = EPI = 6$$

0	1	1	0
0	0	1	0

$$I = 3$$

false Implicant = 5

Comparator

compare

'n' bit

$$\text{Total condition} = 2^{2n}$$

$$\text{Equal condition} = 2^n$$

$$\text{unequal} = 2^{2n} - 2^n$$

$$\text{Greater} = \text{Less} = \frac{2^{2n} - 2^n}{2}$$

Thank you

GW
Soldiers!

