AKTU

GATEWAY CLASSES

Digital System Design

B.Tech. 3rd Sem

EC & Allied



Exam/Result Oriented Content

- ✓ Recorded Video Lectures
- ✓ Pdf Notes
- ✓ PYQs

DIGITAL SYSTEM DESIGN

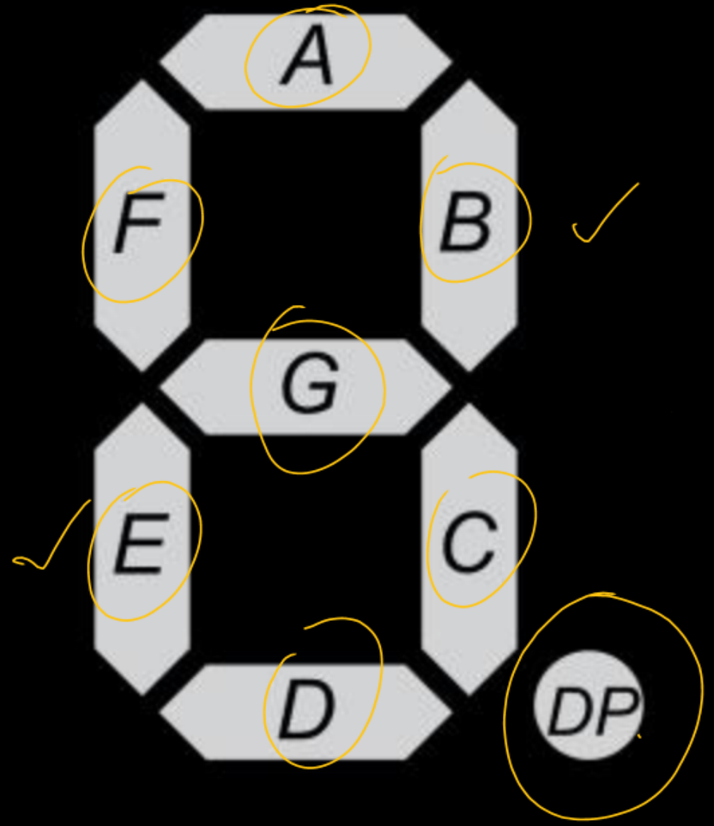
GW GATEWAY CLASSES

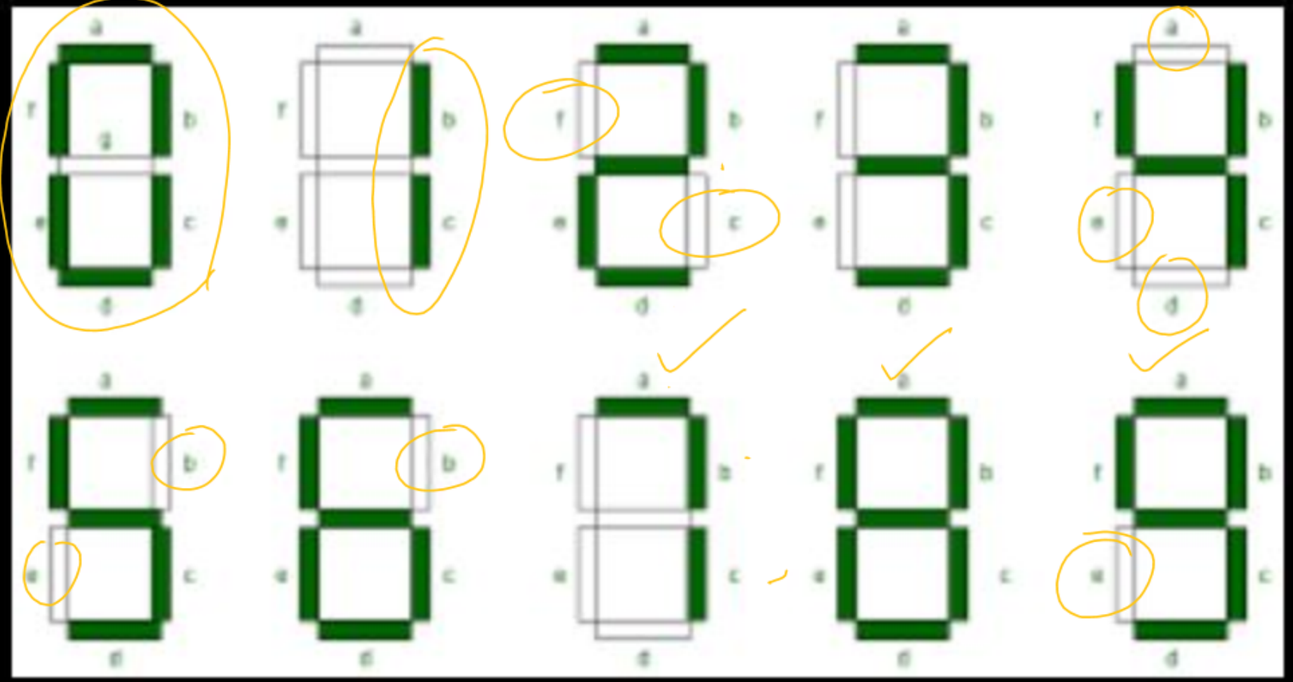
UNIT 2 : Combinational circuits

Today's Target

- Seven Segment Display
- Barrel Shifter
- Shift by 3
- University Questions

SEVEN SEGMENT DISPLAY

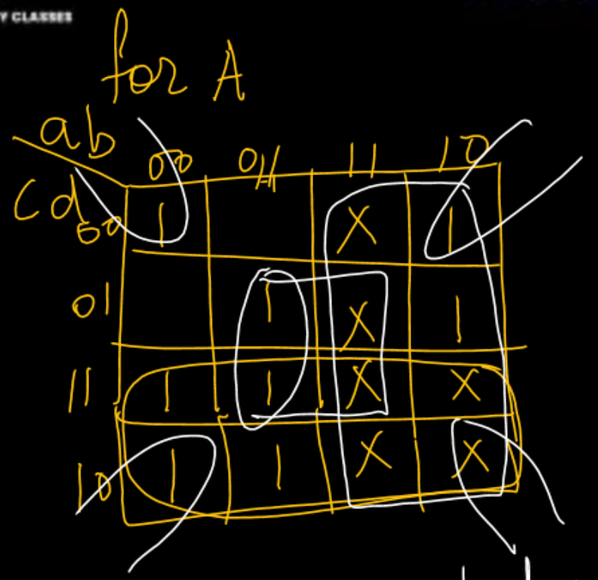




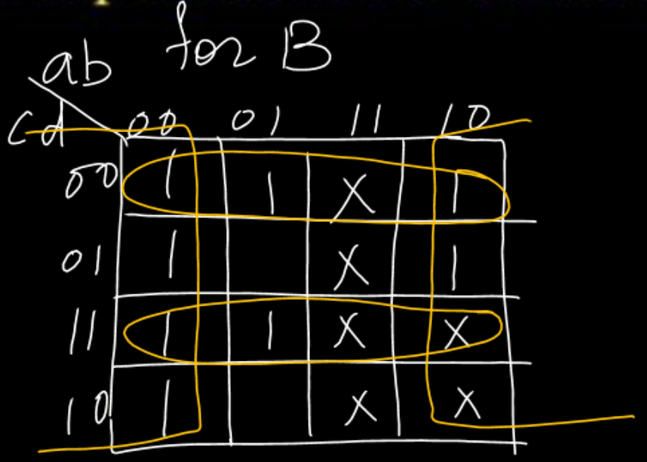
Design a circuit that can display BCD number on seven segment display

Decimal	BCD Input				7 Seven Segment Input						
	a	b	c	d	A	B	C	D	E	F	G
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1

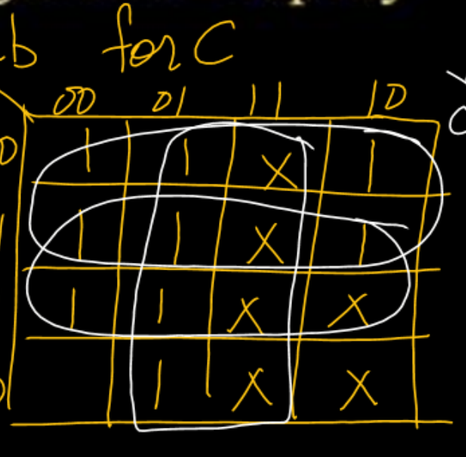
Boolean Expression for Seven Segment Display



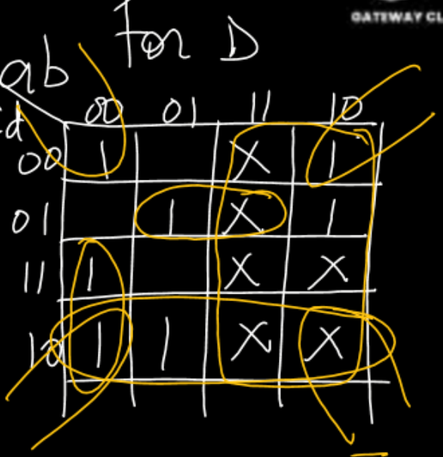
$$A = c + a + bd + \bar{b}\bar{d}$$
$$= c + a + b \odot d$$



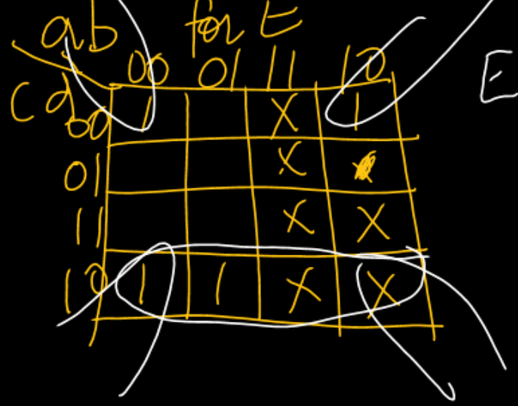
$$B = \bar{b} + \bar{c}\bar{d} + cd$$
$$= \bar{b} + c \odot d$$



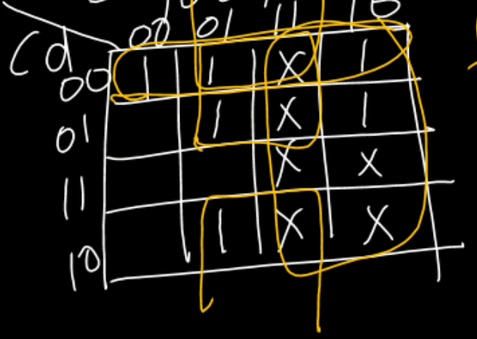
$$C = \bar{c} + d + b$$



$$D = a + c\bar{d} + \bar{a}\bar{b}c + b\bar{c}d + \bar{b}\bar{d}$$



$$E = \bar{b}\bar{d} + c\bar{d}$$
$$= \bar{d}(\bar{b} + c)$$



$$f = a + \bar{c}\bar{d} + b\bar{c} + b\bar{d}$$
$$= a + \bar{c}d + b(\bar{c} + \bar{d})$$



$$G = a + c\bar{d} + b\bar{c} + \bar{b}c$$
$$= a + c\bar{d} + b \oplus c$$

Circuit Diagram for Seven Segment Display

$A = c + a + b \odot d$

$B = \bar{b} + c \odot d$

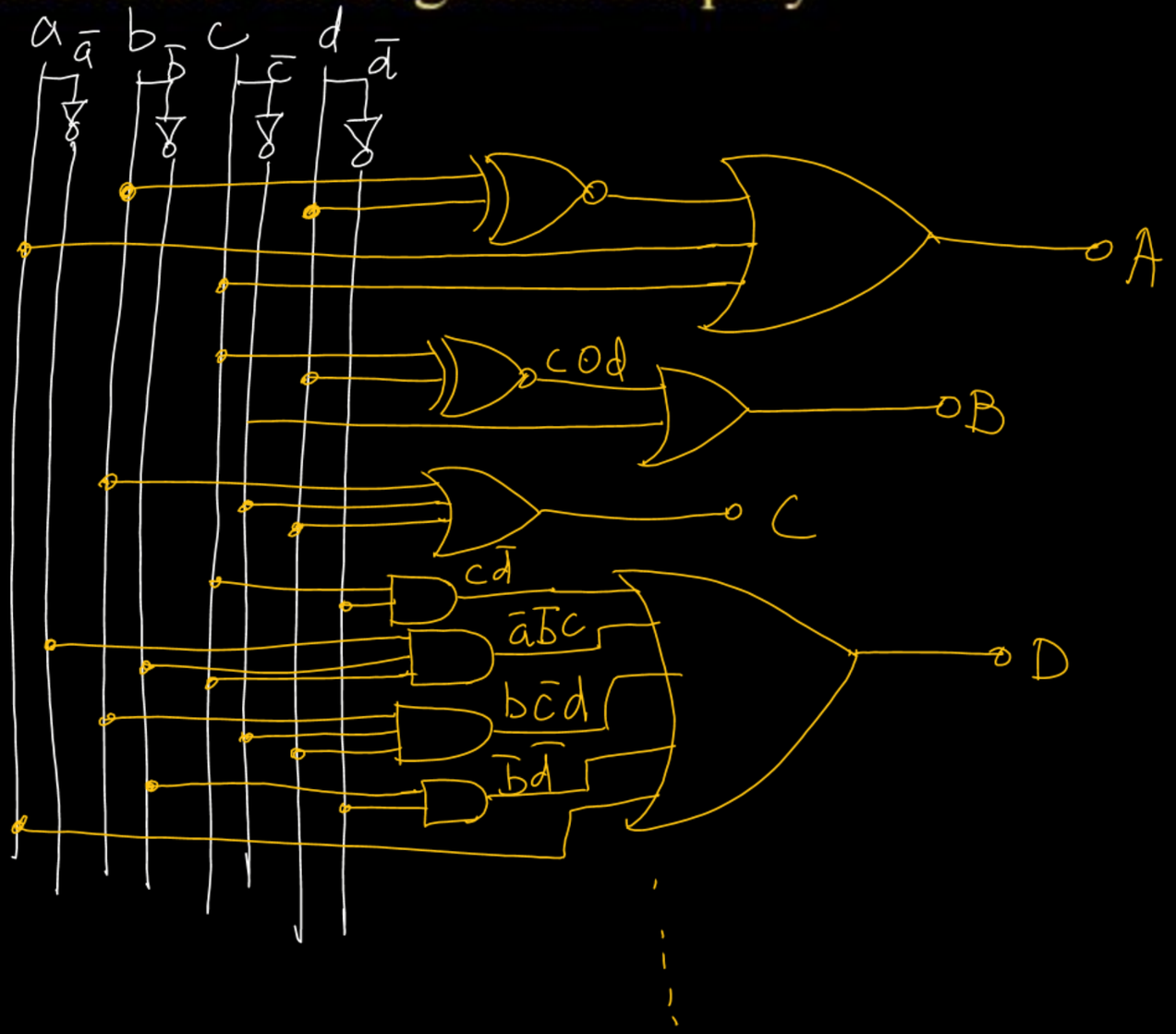
$C = \bar{c} + b + d$

$D = a + c\bar{d} + \bar{a}\bar{b}c + b\bar{c}d + \bar{b}\bar{d}$

$E = \bar{a}(\bar{b} + c)$

$F = a + \bar{c}d + b(\bar{c} + \bar{d})$

$G = a + c\bar{d} + b \oplus c$

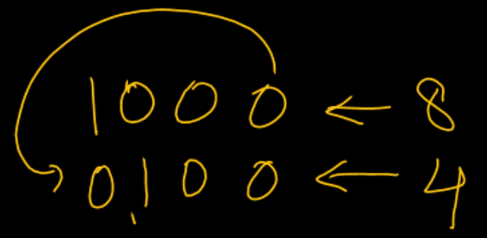




Barrel shifter

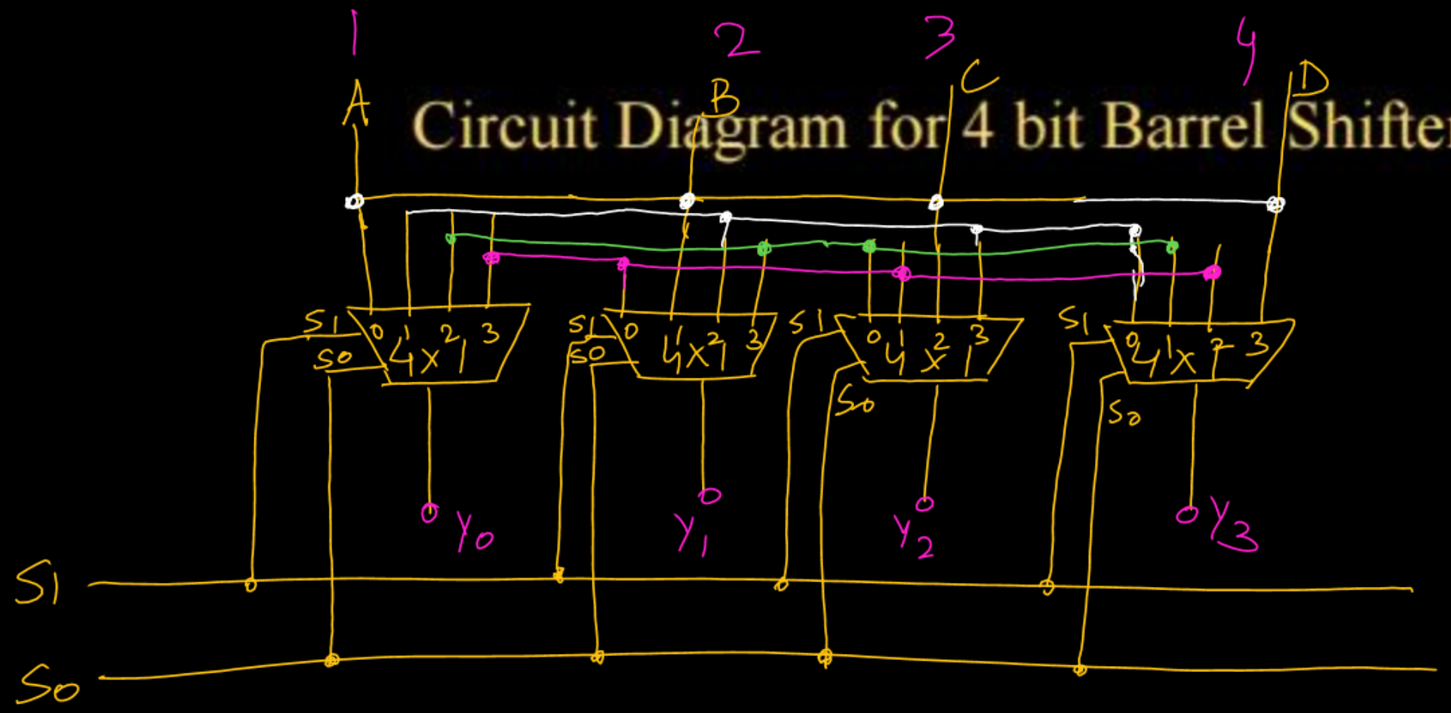
- A **barrel shifter** is a digital circuit that can shift a data word by a specified number of bits without the use of any sequential logic, only pure combinational logic.
- One way to implement a barrel shifter is as a sequence of multiplexers where the output of one multiplexer is connected to the input of the next multiplexer in a way that depends on the shift distance.
- A barrel shifter is often used to shift and rotate n-bits in modern microprocessors, typically within a single clock cycle.

Four-bit Barrel Shifter



- Consider a four-bit barrel shifter, with inputs A, B, C and D.
- The shifter can cycle the order of the bits *ABCD* as *DABC*, *CDAB*, or *BCDA*. That is, it can shift all of the outputs up to three positions to the right.
- The barrel shifter has a variety of applications, including being a useful component in microprocessors.
- A common usage of a barrel shifter is in the hardware implementation of floating-point arithmetic.

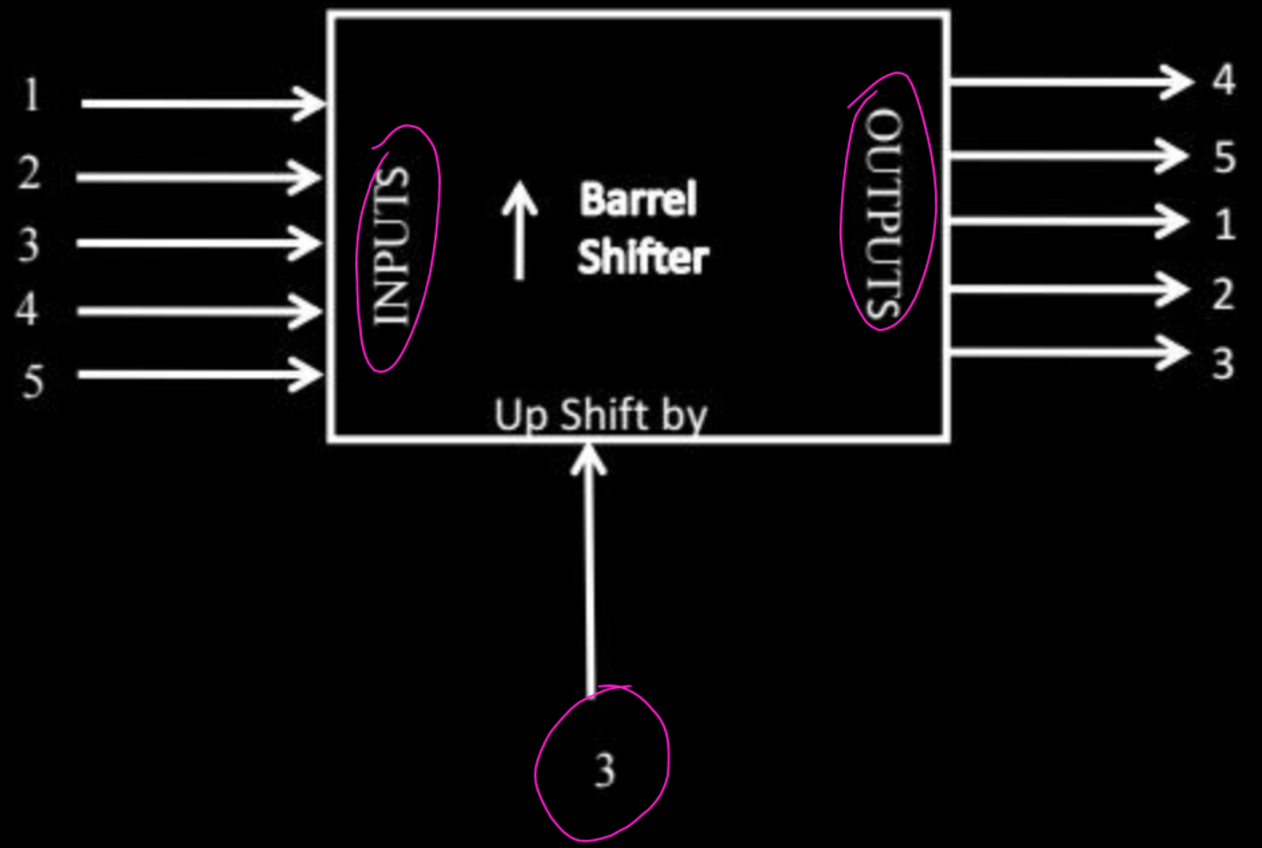
Circuit Diagram for 4 bit Barrel Shifter

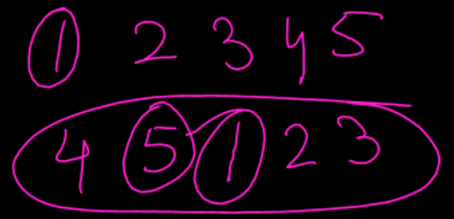


1 2 3 4
→
1

1 2 3 4
4 1 2 3

Block Diagram of Barrel Shifter (Shift by 3 bits)





UNIVERSITY QUESTIONS

YEAR	QUESTION	MARKS
21-22	Distinguish between shifter and barrel shifter?	2 marks
20-21	What is barrel shifter?	2 marks

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Thank You

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