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

UNIT 2 : Combinational circuits

Today's Target

- Binary Adder & Subtractor ✓
- Decimal or BCD Adder ✓

Binary Adder & Subtractor

- Binary addition and subtraction can be done using single circuit.
- This can reduce the cost and space.
- Subtraction is done by 2's compliment method.
- An extra input 'sub' is introduces such that;
- for addition: sub = 0
- For subtraction: sub = 1

I 1001 — 9
II − 0011 — − 3
+6

I 1001
2's 1101
11 0110

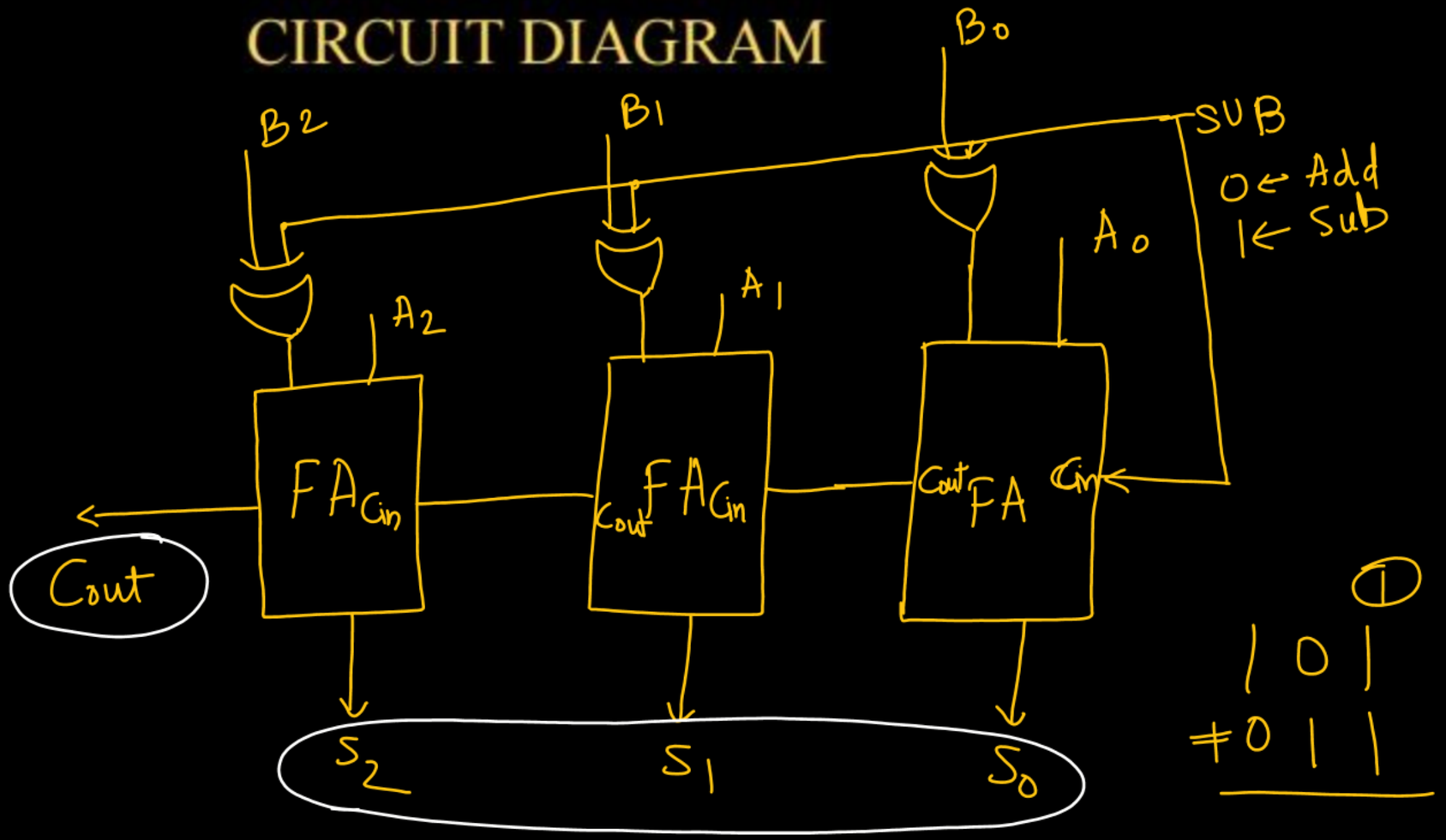
0011
1's 1100
+* 1
2's 1101



	SUB	B	O/P
ADD	0	0	0
	0	1	1
SUB	1	0	1
	1	1	0

1's

CIRCUIT DIAGRAM

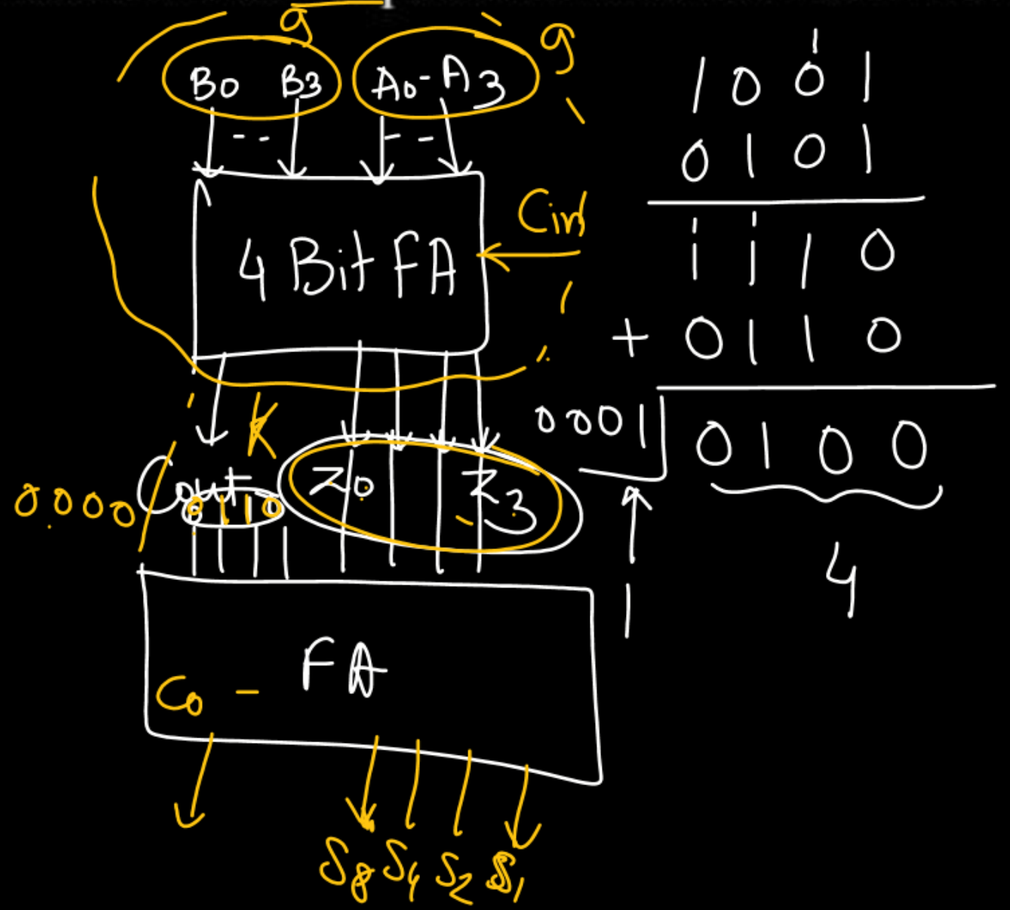


$$\begin{array}{r} 1\,0\,1 \\ +\,0\,1\,1 \\ \hline \end{array}$$

$$\begin{array}{rr} 1's & 1\,0\,0 \\ & +\quad 1 \\ \hline 2's & 1\,0\,1 \end{array} \qquad \begin{array}{r} 1\,0\,1 \\ -\,0\,1\,1 \\ \hline \end{array}$$

Decimal or BCD Adder

- The BCD-Adder is used in the computers and the calculators that perform arithmetic operation directly in the decimal number system.
- The BCD-Adder accepts the binary-coded form of decimal numbers.
- The Decimal-Adder requires a minimum of nine inputs and five outputs.




```
 1001
 0101
 1110
+0110
 0001 | 0100
        4
```

```
  9
 +5
 14
```

0–9 0000 : 1001

```
 1010
 1011
 1100
 1101
 1110
 1111
```

Invalid BCD

Binary Sum					BCD Sum					Decimal
K	Z8	Z4	Z2	Z1	C	S8	S4	S2	S1	Result
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	1	1
0	0	0	1	0	0	0	0	1	0	2
0	0	0	1	1	0	0	0	1	1	3
0	0	1	0	0	0	0	1	0	0	4
0	0	1	0	1	0	0	1	0	1	5
0	0	1	1	0	0	0	1	1	0	6
0	0	1	1	1	0	0	1	1	1	7
0	1	0	0	0	0	1	0	0	0	8
0	1	0	0	1	0	1	0	0	1	9
0	1	0	1	0	1	0	0	0	0	10

$$D = K + Z_8Z_4 + Z_8Z_2$$

Binary Sum					BCD Sum					Decimal
K	Z8	Z4	Z2	Z1	C	S8	S4	S2	S1	
0	1	0	1	1	1	0	0	0	1	11
0	1	1	0	0	1	0	0	1	0	12
0	1	1	0	1	1	0	0	1	1	13
0	1	1	1	0	1	0	1	0	0	14
0	1	1	1	1	1	0	1	0	1	15
1	0	0	0	0	1	0	1	1	0	16
1	0	0	0	1	1	0	1	1	1	17
1	0	0	1	0	1	1	0	0	0	18
1	0	0	1	1	1	1	0	0	1	19

16 8 4 2 1

10000

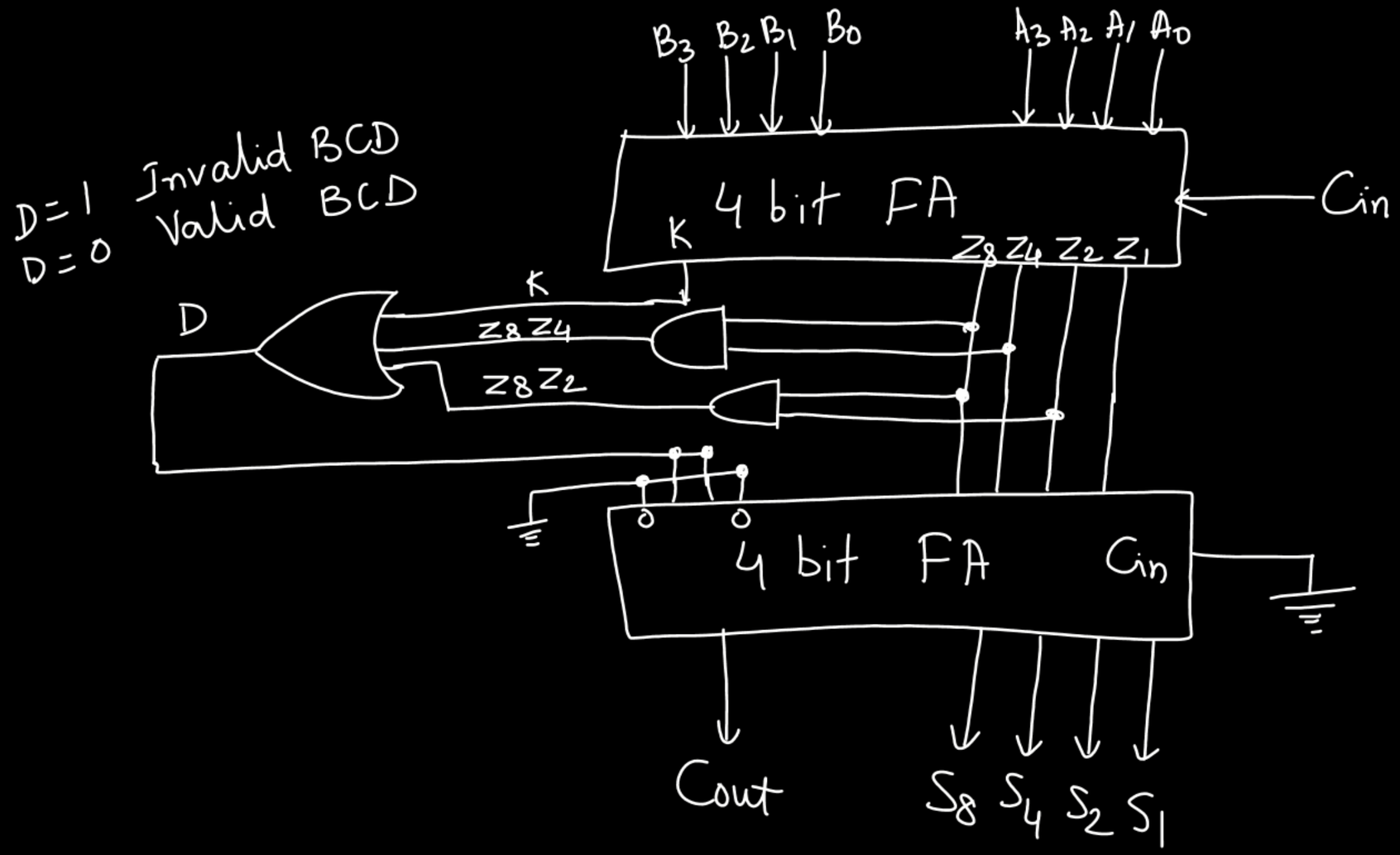
10

00010000

Boolean Expression for Cout

$$C_{out} = K + Z_8 Z_4 + Z_8 Z_2$$

Circuit Diagram for BCD Adder



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Thank You

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