LOGIC DESIGN EET-1021

CHAPTER 04

Lecture 24

Combinational Logic

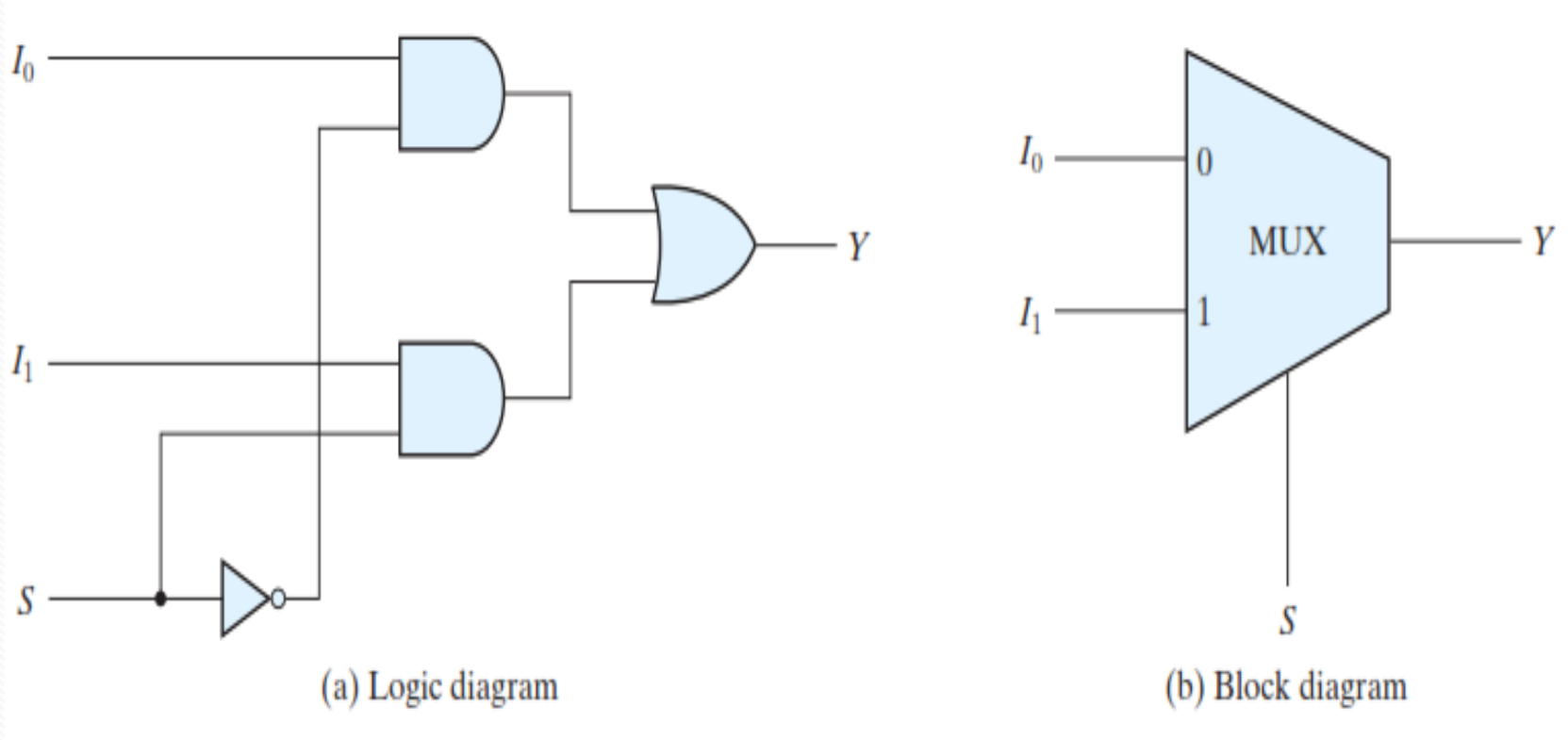
Overview of previous lecture

- **What is a Multiplexer**

Multiplexers

- A multiplexer is a combinational circuit that selects binary information from one of many input lines and directs it to a single output line. The selection of a particular input line is controlled by a set of selection lines. Normally, there are 2^n input lines and n *selection* lines whose bit combinations determine which input is selected.

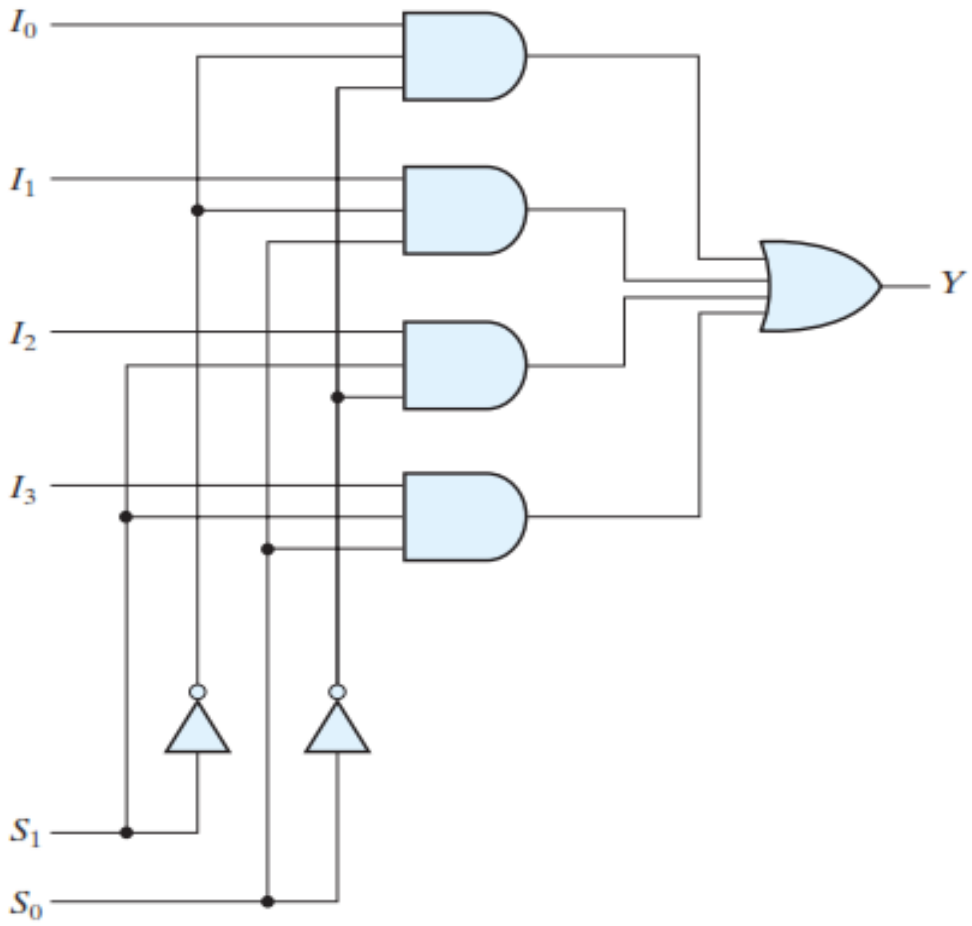
- In general, a 2^n -to-1-line multiplexer is constructed from an n -*to*-2^n decoder by adding 2^n input lines to it, one to each AND gate. The outputs of the AND gates are applied to a single OR gate.



Two-to-one-line multiplexer

HDL for Two-to-One Multiplexer

```
// Dataflow description of two-to-one-line multiplexer
module  mux_2x1_df(Y, Io, I1, s);
 output Y;
 input Io, I1;
 input  s;
assign  Y =  (s)? Io : I1;
endmodule
```



(a) Logic diagram

S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

(b) Function table

Four-to-one-line multiplexer

- **HDL for Four-to-One Multiplexer**

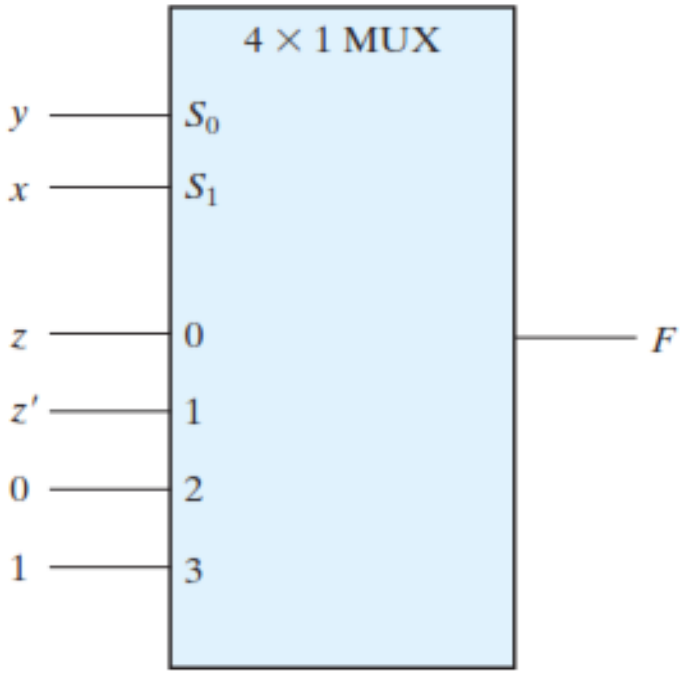
```
// Behavioral description of four-to-one-line multiplexer
module  mux_4x1_beh (Y, I0, I1, I2, I3, s);
output  Y;
 input I0, I1, I2, I3;
  input  [1:0]s;
reg  Y;
 always   @ (I0 or I1 or I2 or I3  or s)
 begin
Case (s)
2' b00:   Y<= I0;
2' b01:   Y<= I1;
2' b10:   Y<= I2;
2' b11:   Y<= I3;
endcase
end


endmodule
```

Boolean Function Implementation

$$F(x, y, z) = \Sigma(1, 2, 6, 7)$$

x	y	z	F	
0	0	0	0	$F = z$
0	0	1	1	
0	1	0	1	$F = z'$
0	1	1	0	
1	0	0	0	$F = 0$
1	0	1	0	
1	1	0	1	$F = 1$
1	1	1	1	

(a) Truth table



(b) Multiplexer implementation

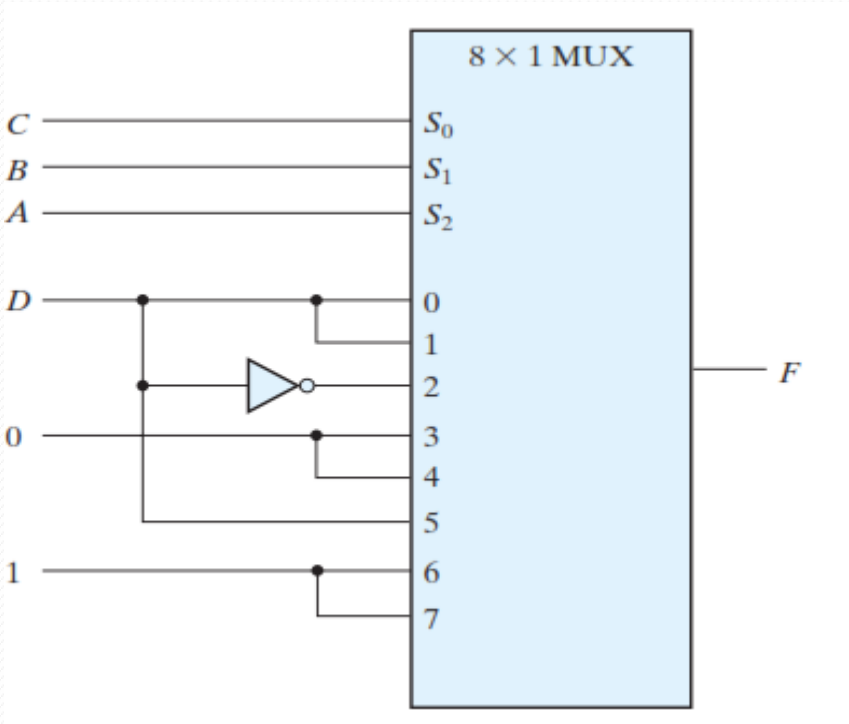
HDL for implementing a Boolean Function using Multiplexer :

```
module booleanfunction (F, z, s);
input z;
input  [1:0]s;
output F;
wire z';
not (z', z);
mux_4x1_beh (F, z, z', 0, 1, s);
endmodule
```

As a second example, consider the implementation of the Boolean function

$$F(A, B, C, D) = \Sigma(1, 3, 4, 11, 12, 13, 14, 15)$$

A	B	C	D	F	
0	0	0	0	0	$F = D$
0	0	0	1	1	
0	0	1	0	0	$F = D$
0	0	1	1	1	
0	1	0	0	1	$F = D'$
0	1	0	1	0	
0	1	1	0	0	$F = 0$
0	1	1	1	0	
1	0	0	0	0	$F = 0$
1	0	0	1	0	
1	0	1	0	0	$F = D$
1	0	1	1	1	
1	1	0	0	1	$F = 1$
1	1	0	1	1	
1	1	1	0	1	$F = 1$
1	1	1	1	1	



Implementing a four-input function with a multiplexer

THANK YOU