ModelSim

LAB # 11

Fall 2020

CSE-304L Computer Organization and Architecture Lab

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Class Section: **B**

"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Student Signature: _____

Submitted to:

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March 18th, 2021

Department of Computer Systems Engineering

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TASK01:

Write a Verilog code for 2x4, 3x8 and 4x16 decoder using Gate Level modeling.

a) 2x4
Code:

source - task1.v

File Edit View Tools Window

```
 1
 2 module decoder_2to4(A,B,F1,F2,F3,F4);
 3         input A,B;
 4         output F1,F2,F3,F4;
 5         wire nA,nB;
 6         not n1(nA,A);
 7         not n2(nB,B);
 8         and a1(F1,nA,nB);
 9         and a2(F2,nA,B);
10         and a3(F3,A,nB);
11         and a4(F4,A,B);
12 endmodule
```

source - task1b.v

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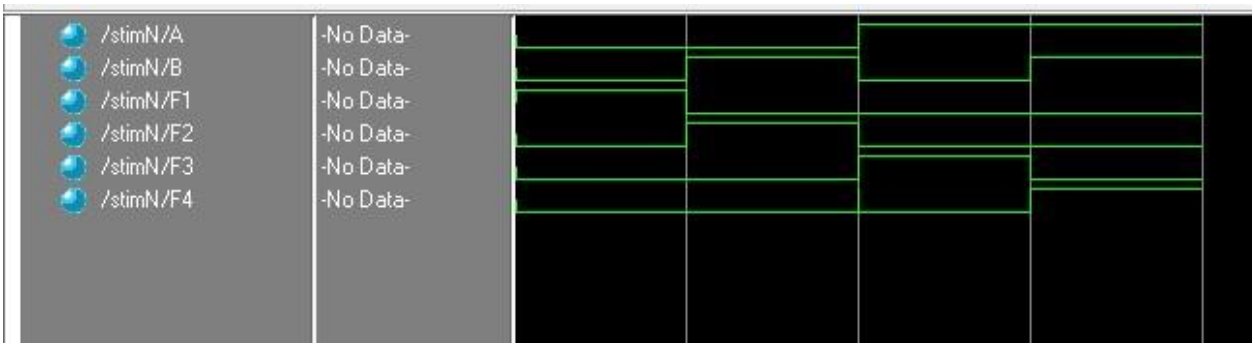
```
 1
 2 module stimN;
 3         reg A,B;
 4         wire F1,F2,F3,F4;
 5         decoder_2to4 inst(A,B,F1,F2,F3,F4);
 6         initial
 7         begin
 8                 $display("A B   F1      F2      F3      F4");
 9                 A = 0;
10                 B = 0;
11                 $display("%b %b %b      %b      %b      %b",A,B,F1,F2,F3,F4);
12                 #5;
13                 A = 0;
14                 B = 1;
15                 $display("%b %b %b      %b      %b      %b",A,B,F1,F2,F3,F4);
16                 #5;
17                 A = 1;
18                 B = 0;
19                 $display("%b %b %b      %b      %b      %b",A,B,F1,F2,F3,F4);
20                 #5;
21                 A = 1;
22                 B = 1;
23                 $display("%b %b %b      %b      %b      %b",A,B,F1,F2,F3,F4);
24                 #5;
25         end
26 endmodule
27
28
```

Output Wave:



---

b) 3x8

Code:

source - task3.v

File Edit View Tools Window

100 ns

ln #

```
 1 module task1(a,b,c,d0,d1,d2,d3,d4,d5,d6,d7);
 2         input a,b,c;
 3         output d0,d1,d2,d3,d4,d5,d6,d7;
 4         not g10(na,a);
 5         not g11(nb,b);
 6         not g12(nc,c);
 7         and g0(d0,na,nb,nc);
 8         and g1(d1,na,nb,c);
 9         and g2(d2,na,b,nc);
10         and g3(d3,na,b,c);
11         and g4(d4,a,nb,nc);
12         and g5(d5,a,nb,c);
13         and g6(d6,a,b,nc);
14         and g7(d7,a,b,c);
15 endmodule
16
```

source - task2b.v

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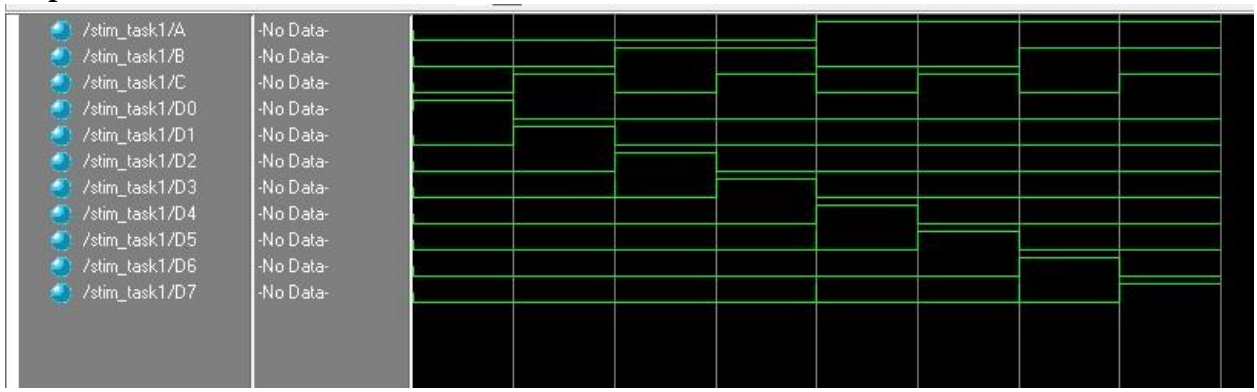
E:/5TH SEMESTER/COA LAB/Modelsim Lab2/task2b.v

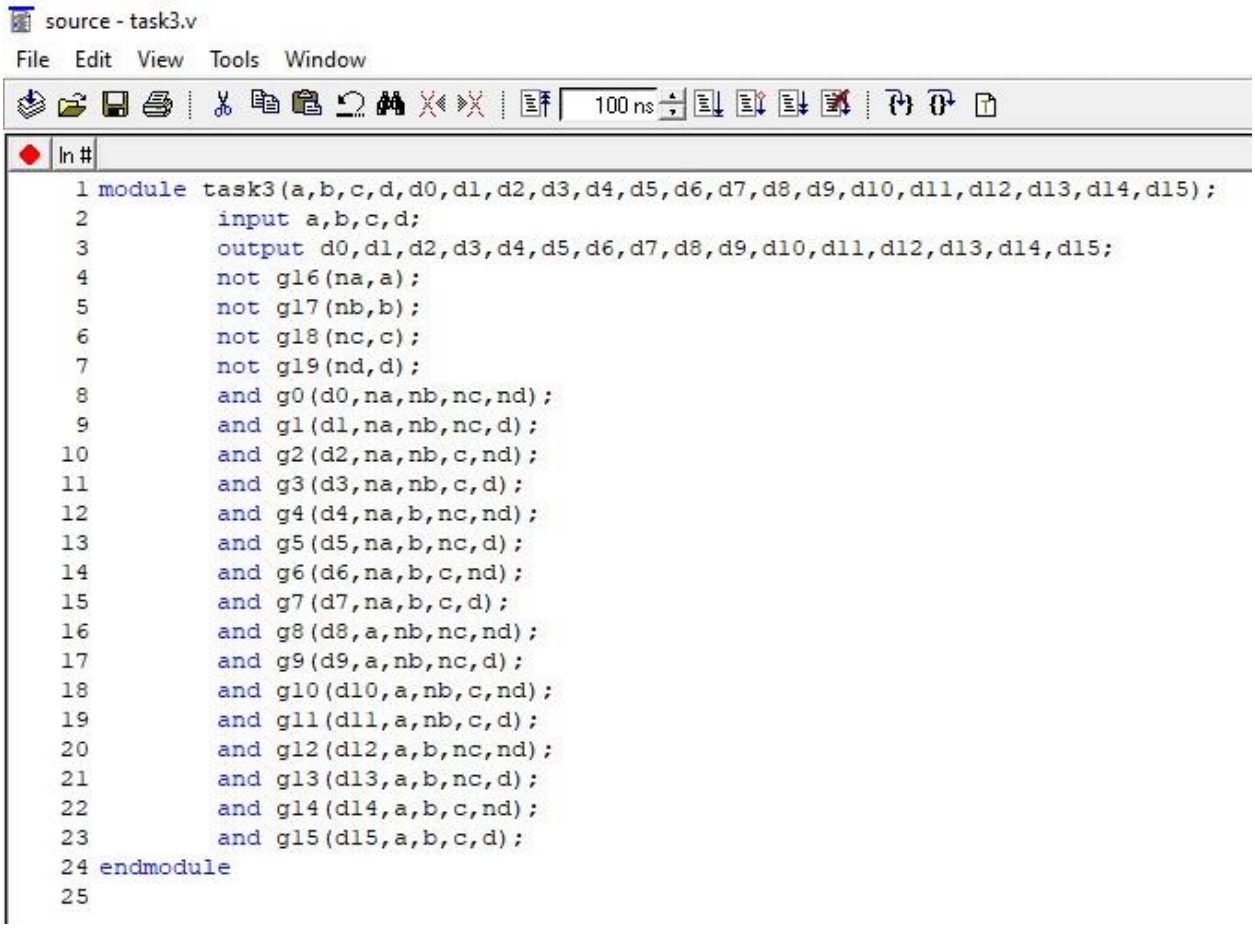
```
1
2  module stim_task1();
3          reg A,B,C;
4          wire D0,D1,D2,D3,D4,D5,D6,D7;
5          task1 inst(A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
6          initial
7          begin
8                  $display("A     B       C       D0      D1      D2      D3      D4      D5      D6      D7");
9                  A=0;B=0;C=0;
10                 #1 $display("%b  %b      %b      %b      %b      %b      %b      %b      %b      %b      %b",A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
11                 A=0;B=0;C=1;
12                 #1 $display("%b  %b      %b      %b      %b      %b      %b      %b      %b      %b      %b",A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
13                 A=0;B=1;C=0;
14                 #1 $display("%b  %b      %b      %b      %b      %b      %b      %b      %b      %b      %b",A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
15                 A=0;B=1;C=1;
16                 #1 $display("%b  %b      %b      %b      %b      %b      %b      %b      %b      %b      %b",A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
17                 A=1;B=0;C=0;
18                 #1 $display("%b  %b      %b      %b      %b      %b      %b      %b      %b      %b      %b",A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
19                 A=1;B=0;C=1;
20                 #1 $display("%b  %b      %b      %b      %b      %b      %b      %b      %b      %b      %b",A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
21                 A=1;B=1;C=0;
22                 #1 $display("%b  %b      %b      %b      %b      %b      %b      %b      %b      %b      %b",A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
23                 A=1;B=1;C=1;
24                 #1 $display("%b  %b      %b      %b      %b      %b      %b      %b      %b      %b      %b",A,B,C,D0,D1,D2,D3,D4,D5,D6,D7);
25         end
26 endmodule
```

Output Wave:



c) 4x16

Code:

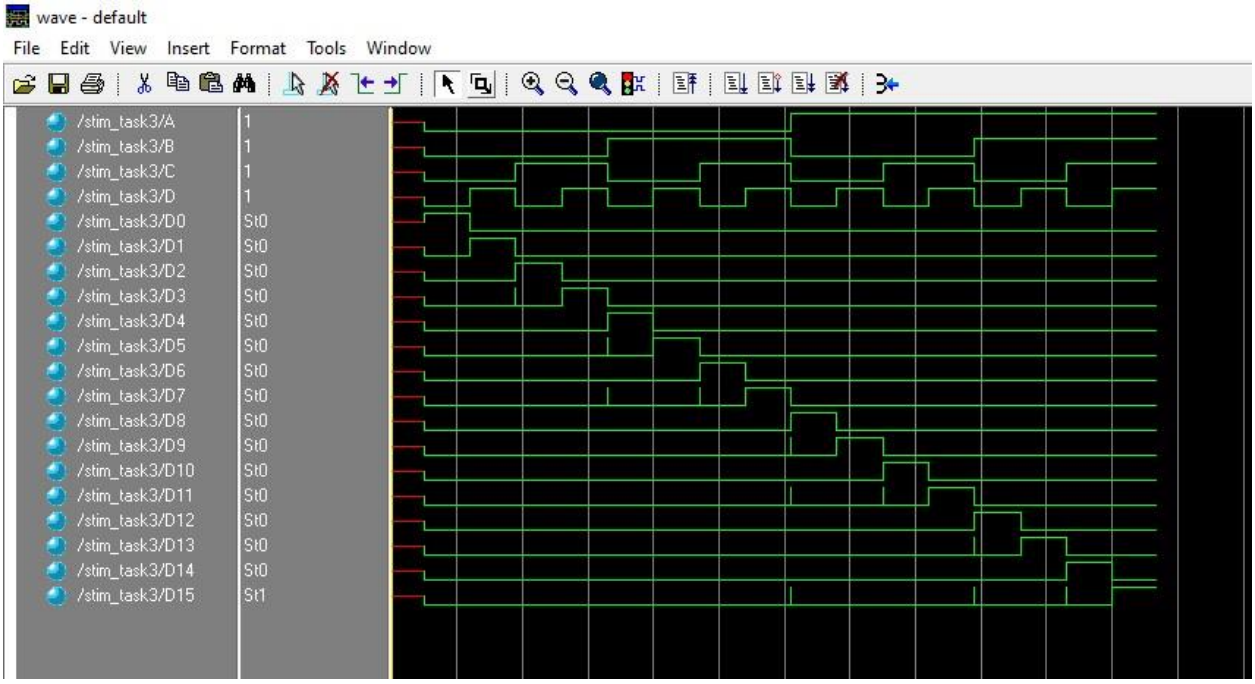



```
 1 module task3(a,b,c,d,d0,d1,d2,d3,d4,d5,d6,d7,d8,d9,d10,d11,d12,d13,d14,d15);
 2         input a,b,c,d;
 3         output d0,d1,d2,d3,d4,d5,d6,d7,d8,d9,d10,d11,d12,d13,d14,d15;
 4         not g16(na,a);
 5         not g17(nb,b);
 6         not g18(nc,c);
 7         not g19(nd,d);
 8         and g0(d0,na,nb,nc,nd);
 9         and g1(d1,na,nb,nc,d);
10         and g2(d2,na,nb,c,nd);
11         and g3(d3,na,nb,c,d);
12         and g4(d4,na,b,nc,nd);
13         and g5(d5,na,b,nc,d);
14         and g6(d6,na,b,c,nd);
15         and g7(d7,na,b,c,d);
16         and g8(d8,a,nb,nc,nd);
17         and g9(d9,a,nb,nc,d);
18         and g10(d10,a,nb,c,nd);
19         and g11(d11,a,nb,c,d);
20         and g12(d12,a,b,nc,nd);
21         and g13(d13,a,b,nc,d);
22         and g14(d14,a,b,c,nd);
23         and g15(d15,a,b,c,d);
24 endmodule
25
```

```
1
2 module stim_task3();
3         reg A,B,C,D;
4         wire D0,D1,D2,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12,D13,D14,D15;
5         task3 inst(A,B,C,D,D0,D1,D2,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
6         initial
7         begin
8                 $display("A     B       C       D       D0      D1      D2      D3      D4      D5");
9                 $display("D6 D7 D8      D9      D10     D11     D12     D13     D14     D15");
10                #5;
11                A=0;B=0;C=0;D=0;
12                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
13                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
14                #5;
15                A=0;B=0;C=0;D=1;
16                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
17                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
18                #5;
19                A=0;B=0;C=1;D=0;
20                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
21                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
22                #5;
23                A=0;B=0;C=1;D=1;
24                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
25                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
26                #5;
27                A=0;B=1;C=0;D=0;
28                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
29                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
30                #5;
31                A=0;B=1;C=0;D=1;
32                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
33                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
34                #5;
35                A=0;B=1;C=1;D=0;
36                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
37                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
38                #5;


39                A=0;B=1;C=1;D=1;
40                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
41                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
42                #5;
43                A=1;B=0;C=0;D=0;
44                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
45                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
46                #5;
47                A=1;B=0;C=0;D=1;
48                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
49                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
50                #5;
51                A=1;B=0;C=1;D=0;
52                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
53                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
54                #5;
55                A=1;B=0;C=1;D=1;
56                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
57                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
58                #5;
59                A=1;B=1;C=0;D=0;
60                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
61                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
62                #5;
63                A=1;B=1;C=0;D=1;
64                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
65                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
66                #5;
67                A=1;B=1;C=1;D=0;
68                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
69                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
70                #5;
71                A=1;B=1;C=1;D=1;
72                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",A,B,C,D,D0,D1,D2,D3,D4,D5);
73                #1 $display("%b %b %b   %b      %b      %b      %b      %b      %b      %b",D6,D7,D8,D9,D10,D11,D12,D13,D14,D15);
74                #5;
75
76        end
77 endmodule
```

Output Wave:

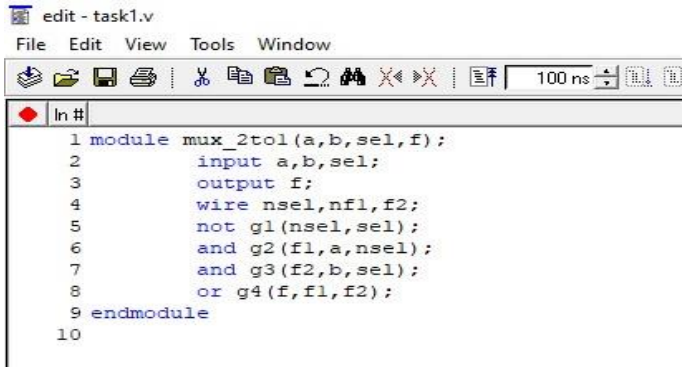


TASK02:

Write a Verilog code for 2x1, 4x1 and 8x1 multiplexer using Gate Level modeling.

a) 2x1

Code:



edit - task1b.v

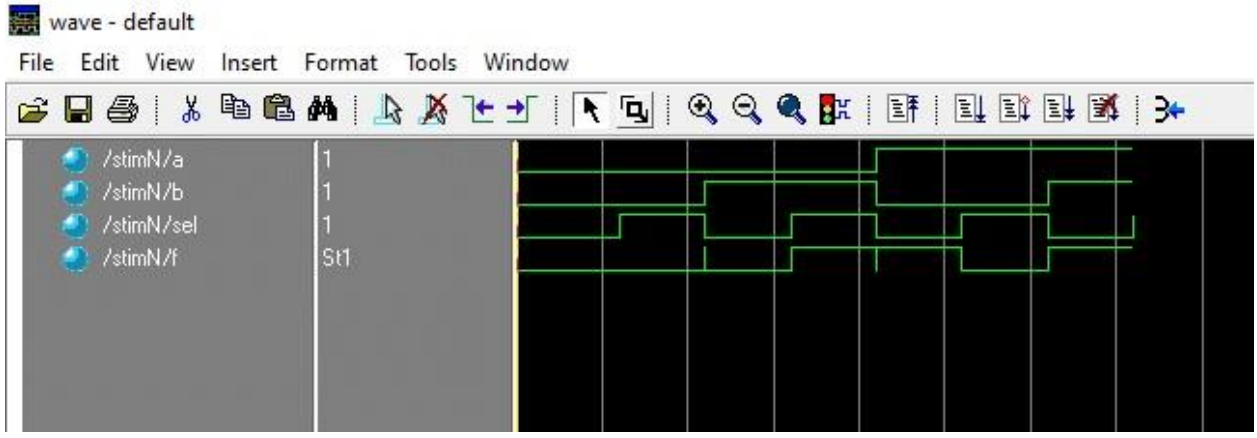
File Edit View Tools Window

100 ns

ln #

```
 1
 2 module stimN();
 3         reg a,b,sel;
 4         wire f;
 5         mux_2to1 M(a,b,sel,f);
 6         initial
 7         begin
 8                 $display("A B SEL F");
 9                 a=0;
10                 b=0;
11                 sel=0;
12                 #1 $display("%b %b %b %b",a,b,sel,f);
13                 #5 a=0;
14                 b=0;
15                 sel=1;
16                 $display("%b %b %b %b",a,b,sel,f);
17                 #5 a=0;
18                 b=1;
19                 sel=0;
20                 $display("%b %b %b %b",a,b,sel,f);
21                 #5 a=0;
22                 b=1;
23                 sel=1;
24                 $display("%b %b %b %b",a,b,sel,f);
25                 #5 a=1;
26                 b=0;
27                 sel=0;
28                 $display("%b %b %b %b",a,b,sel,f);
29                 #5 a=1;
30                 b=0;
31                 sel=1;
32                 $display("%b %b %b %b",a,b,sel,f);
33                 #5 a=1;
34                 b=1;
35                 sel=0;
36                 $display("%b %b %b %b",a,b,sel,f);
37                 #5 a=1;
38                 b=1;
39                 sel=1;
40                 $display("%b %b %b %b",a,b,sel,f);
41         end
42 endmodule
```

Output Wave:



---

b) 4x1

Code:

```
 1
 2 module mux_4to1(s1,s2,d0,d1,d2,d3,f);
 3         input s1,s2,d0,d1,d2,d3;
 4         output f;
 5         wire ns1,ns2,a0,a1,a2,a3,aa0,aa1,aa2,aa3,on1,on2;
 6         not n1(ns1,s1);
 7         not n2(ns2,s2);
 8         and g1(a0,ns1,ns2);
 9         and g11(aa0,a0,d0);
10         and g2(a1,ns1,s2);
11         and g22(aa1,a1,d1);
12         and g3(a2,s1,ns2);
13         and g33(aa2,a2,d2);
14         and g4(a3,s1,s2);
15         and g44(aa3,a3,d3);
16         or o1(on1,aa0,aa1);
17         or o2(on2,aa2,aa3);
18         or o3(f,on1,on2);
19 endmodule
```

```
module stim_mux4to1;
reg s1,s2,d0,d1,d2,d3;
wire f;
        mux_4to1 multi(s1,s2,d0,d1,d2,d3,f);
initial
        begin
                $display("SEL1 SEL2 D0 D1 D2 D3");
                s1=0;
s2=0;
                d0=0;d1=0;d2=0;d3=0;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5;
                s1 = 0;
        s2 = 0;
                d0 = 0; d1 = 0; d2 = 0; d3 = 1;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5;
                s1 = 0;
        s2 = 0;
                d0 = 0; d1 = 0; d2 = 1; d3 = 0;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5;
                s1 = 0;
        s2 = 0;
                d0 = 0; d1 = 0; d2 = 1; d3 = 1;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5;
                s1 = 0;
        s2 = 0;
                d0 = 0; d1 = 1; d2 = 0; d3 = 0;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5;
                s1 = 0;
        s2 = 0;
                d0 = 0; d1 = 1; d2 = 0; d3 = 1;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
```

```
        #5;
        s1 = 0;
s2 = 0;
        d0 = 0; d1 = 1; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0; s2
        = 0;
        d0 = 1; d1 = 0; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5; s1
        = 0;
        s2 =
        0;
        d0 = 1; d1 = 0; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 0;
        d0 = 1; d1 = 0; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 0;
        d0 = 1; d1 = 0; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 0;
        d0 = 1; d1 = 1; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
```

```
        #5;
        s1 = 0;
s2 = 0;
        d0 = 1; d1 = 1; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 0;
        d0 = 1; d1 = 1; d2 = 1; d3 = 0;
        #1 $display("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 0;
        d0 = 1; d1 = 1; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 1;
        d0 = 0; d1 = 0; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
        s2 = 1;
        d0 = 0; d1 = 0; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f); #5;
        s1 = 0; s2
        = 1;
        d0 = 0; d1 = 0; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 1;
        d0 = 0; d1 = 0; d2 = 1; d3 = 1;
```

```
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 1;
        d0 = 0; d1 = 1; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 1;
        d0 = 0; d1 = 1; d2 = 0; d3 = 1;
        #1 $display("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 1;
        d0 = 0; d1 = 1; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 1;
        d0 = 1; d1 = 0; d2 = 0; d3 = 0;
        #1 $display("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 1;
        d0 = 1; d1 = 0; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
s2 = 1;
        d0 = 1; d1 = 0; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
```

```
        #5;
        s1 = 0;
    s2 = 1;
        d0 = 1; d1 = 0; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5; s1
        = 0;
        s2 =
        1;
        d0 = 1; d1 = 1; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5; s1
= 0;    s2 = 1;
        d0 = 1; d1 = 1; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
    s2 = 1;
        d0 = 1; d1 = 1; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 0;
    s2 = 1;
        d0 = 1; d1 = 1; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
    s2 = 0;
        d0 = 0; d1 = 0; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
    s2 = 0;
```

```
                d0 = 0; d1 = 0; d2 = 0; d3 = 1;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5;
                s1 = 1;
        s2 = 0;
                d0 = 0; d1 = 0; d2 = 1; d3 = 0;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5;
                s1 = 1;
        s2 = 0;
                d0 = 0; d1 = 0; d2 = 1; d3 = 1;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5;
                s1 = 1;
        s2 = 0;
                d0 = 0; d1 = 1; d2 = 0; d3 = 0;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5; s1
                = 1;
                s2 =
                0; d0
                = 0;
                d1 =
                1; d2
                = 0;
                d3 =
                1;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
                #5; s1 = 1; s2 = 0;
d0 = 0; d1 = 1; d2 = 1; d3 = 1;
                #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
```

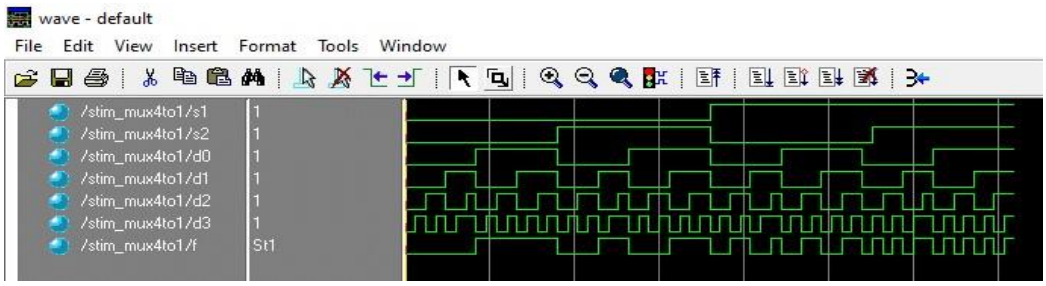
```
        #5;
        s1 = 1;
s2 = 0;
        d0 = 1; d1 = 0; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 0;
        d0 = 1; d1 = 0; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 0;
        d0 = 1; d1 = 0; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 0;
        d0 = 1; d1 = 0; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 0;
        d0 = 1; d1 = 1; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 0;
        d0 = 1; d1 = 1; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 0;
```

```
        d0 = 1; d1 = 1; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5; s1
        = 1;
        s2 =
        0;
        d0 = 1; d1 = 1; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5; s1
        = 1;
        s2 =
        0;
        d0 = 0; d1 = 0; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 1;
        d0 = 0; d1 = 0; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 1;
        d0 = 0; d1 = 0; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 1;
        d0 = 0; d1 = 0; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 1;
        d0 = 0; d1 = 1; d2 = 0; d3 = 0;
```

```
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 1;
        d0 = 0; d1 = 1; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 1;
        d0 = 0; d1 = 1; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 1;
        d0 = 1; d1 = 0; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1; s2
        = 1;
        d0 = 1; d1 = 0; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5; s1
        = 1;
        s2 =
        1;
        d0 = 1; d1 = 0; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
s2 = 1;
        d0 = 1; d1 = 0; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
```

```
        #5;
        s1 = 1;
    s2 = 1;
        d0 = 1; d1 = 1; d2 = 0; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
    s2 = 1;
        d0 = 1; d1 = 1; d2 = 0; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
    s2 = 1;
        d0 = 1; d1 = 1; d2 = 1; d3 = 0;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
        s1 = 1;
    s2 = 1;
        d0 = 1; d1 = 1; d2 = 1; d3 = 1;
        #1 $ display ("%b %b %b %b %b %b %b",s1,s2,d0,d1,d2,d3,f);
        #5;
    end
endmodule
```

Output Wave:



c) 8x1

Code:

edit - mux8to1a.v

File Edit View Tools Window

```
 1
 2 module mux_8to1(s1,s2,s3,in0,in1,in2,in3,in4,in5,in6,in7,f);
 3         input s1,s2,s3,in0,in1,in2,in3,in4,in5,in6,in7;
 4         output f;
 5         wire ns1,ns2,ns3,a0,a1,a2,a3,a4,a5,a6,a7;
 6         not n1(ns1,s1);
 7         not n2(ns2,s2);
 8         not n3(ns3,s3);
 9         and g0(a0,ns1,ns2,ns3,in0);
10         and g1(a1,s1,ns2,ns3,in1);
11         and g2(a2,ns1,s2,ns3,in2);
12         and g3(a3,s1,s2,ns3,in3);
13         and g4(a4,ns1,ns2,s3,in4);
14         and g5(a5,s1,ns2,s3,in5);
15         and g6(a6,ns1,s2,s3,in6);
16         and g7(a7,s1,s2,s3,in7);
17         or o1(f,a0,a1,a2,a3,a4,a5,a6,a7);
18 endmodule
```

```
1
2 module stim_8to1;
3         reg s1,s2,s3,in0,in1,in2,in3,in4,in5,in6,in7;
4         wire f;
5         mux_8to1 multipl(s1,s2,s3,in0,in1,in2,in3,in4,in5,in6,in7,f);
6         initial
7         begin
8                 $display("SEL3 SEL2 SEL1 IN7 IN6 IN5 IN4 IN3 IN2 IN1 IN0 F");
9                 s1 = 0; s2 = 0; s3 = 0;
10                in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
11                #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
12                #5;
13
14                s1 = 0; s2 = 0; s3 = 0;
15                in0=1;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
16                #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
17                #5;
18
19                s1 = 1; s2 = 0; s3 = 0;
20                in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
21                #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
22                #5;
23
24                s1 = 1; s2 = 0; s3 = 0;
25                in0=0;in1=1;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
26                #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
27                #5;
28
29                s1 = 0; s2 = 1; s3 = 0;
30                in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
31                #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
32                #5;
33
34                s1 = 0; s2 = 1; s3 = 0;
35                in0=0;in1=0;in2=1;in3=0;in4=0;in5=0;in6=0;in7=0;
36                #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
37                #5;
38
39                s1 = 1; s2 = 1; s3 = 0;
40                in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
41                #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
42                #5;
```

```
44                 s1 = 1; s2 = 1; s3 = 0;
45                 in0=0;in1=0;in2=0;in3=1;in4=0;in5=0;in6=0;in7=0;
46                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
47                 #5;
48
49                 s1 = 0; s2 = 0; s3 = 1;
50                 in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
51                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
52                 #5;
53
54                 s1 = 0; s2 = 0; s3 = 1;
55                 in0=0;in1=0;in2=0;in3=0;in4=1;in5=0;in6=0;in7=0;
56                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
57                 #5;
58
59                 s1 = 1; s2 = 0; s3 = 1;
60                 in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
61                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
62                 #5;
63
64                 s1 = 1; s2 = 0; s3 = 1;
65                 in0=0;in1=0;in2=0;in3=0;in4=0;in5=1;in6=0;in7=0;
66                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
67                 #5;
68
69                 s1 = 0; s2 = 1; s3 = 1;
70                 in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
71                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
72                 #5;
73
74                 s1 = 0; s2 = 1; s3 = 1;
75                 in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=1;in7=0;
76                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
77                 #5;
78
79                 s1 = 1; s2 = 1; s3 = 1;
80                 in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=0;
81                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
82                 #5;
83                 s1 = 1; s2 = 1; s3 = 1;
84                 in0=0;in1=0;in2=0;in3=0;in4=0;in5=0;in6=0;in7=1;
85                 #1 $display("%b %b %b %b %b %b %b %b %b %b %b %b",s3,s2,s1,in7,in6,in5,in4,in3,in2,in1,in0,f);
86                 #5;
87         end
88 endmodule
```

Output Wave: