#50DAYS CHALLENGE

DECODER

a)Design Code

```verilog
module decoder2_4(en,il,i0,y);
output   [3:0]y;
input en,il,i0;

assign y[0]=(en& ~il & ~i0);

assign y[1]=(en& ~il & i0);

assign y[2]=(en& il & ~i0);

assign y[3]=(en& il & i0);

endmodule
```

b)Testbench

```verilog
module decoder2_4_tb();
reg en,il,i0;
wire [3:0]y;
integer i;

decoder2_4 dut(.en(en),.il(il),.i0(i0),.y(y));

initial
begin
{en,il,i0}=3'b0;
end

initial
begin
        for(i=0;i<8;i=i+1)
begin
      {en,il,i0}=i;
#10;

end
end

initial
$monitor(" input en=%b il=%b i0=%b and output [3:0]y=%b",en,il,i0,y);
initial
#200 $finish();
endmodule
```
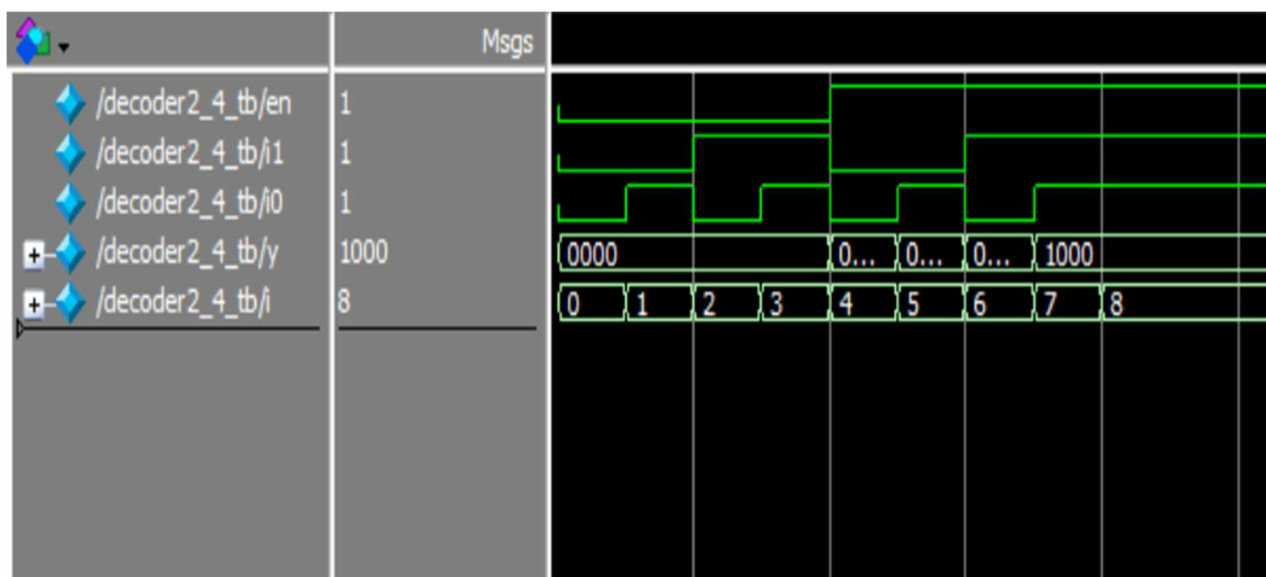
c)Waveform

/decoder2_4_tb/en	1
/decoder2_4_tb/i1	1
/decoder2_4_tb/i0	1
/decoder2_4_tb/y	1000
/decoder2_4_tb/i	8

d)Console Output

```
#    input en=0 il=0 i0=0 and output [3:0]y=0000
#    input en=0 il=0 i0=1 and output [3:0]y=0000
#    input en=0 il=1 i0=0 and output [3:0]y=0000
#    input en=0 il=1 i0=1 and output [3:0]y=0000
#    input en=1 il=0 i0=0 and output [3:0]y=0001
#    input en=1 il=0 i0=1 and output [3:0]y=0010
#    input en=1 il=1 i0=0 and output [3:0]y=0100
#    input en=1 il=1 i0=1 and output [3:0]y=1000
```

RECONFIGURABLE DECODER

a)Design Code

```verilog
module reconfigurable_decoder #(parameter N=3)
        ( input [N-1:0] sel,
          input en,
                output reg [(1<<N)-1:0]y);
always@(*)
begin

y={((1<<N)){1'b0}};
y[sel]=1'b1;
end
endmodule
```

b)Testbench

```verilog
`timescale 1ns/1ps
module tb_reconfigurable_decoder;

parameter N=3;
reg   [N-1:0] sel;
reg en;
wire [(1<<N)-1:0] y;

reconfigurable_decoder #(N) dut (.sel(sel),.en(en),.y(y));

integer k;
initial
begin

{en,sel}=0;
#10;
en=1;
for(k=0;k<(1<<N);k=k+1)
begin
sel=k;
#10;
end

en=0;
#10;
$finish;
end

initial
begin
$monitor("Time=%t |en=%b |sel=%d |y=%b |",$time,en,sel,y);
end
endmodule
```
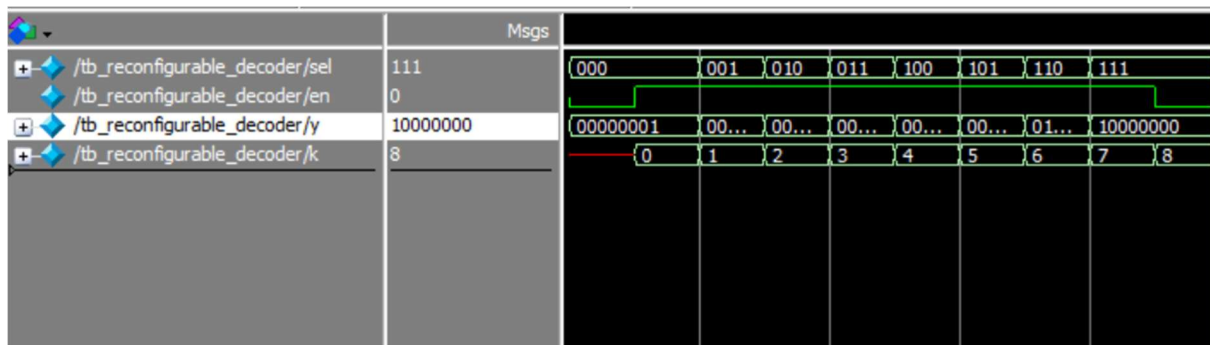
c)Waveform

d)Console Output

```
# Time=          0 |en=0 |sel=0 |y=00000001 |
# Time=      10000 |en=1 |sel=0 |y=00000001 |
# Time=      20000 |en=1 |sel=1 |y=00000010 |
# Time=      30000 |en=1 |sel=2 |y=00000100 |
# Time=      40000 |en=1 |sel=3 |y=00001000 |
# Time=      50000 |en=1 |sel=4 |y=00010000 |
# Time=      60000 |en=1 |sel=5 |y=00100000 |
# Time=      70000 |en=1 |sel=6 |y=01000000 |
# Time=      80000 |en=1 |sel=7 |y=10000000 |
# Time=      90000 |en=0 |sel=7 |v=10000000 |
```