

## Week 5:

Q1:

```
module dec2to4(w,e,Y);
input[1:0]w;
input e;
output [0:3]Y;
reg [0:3]Y;
always@(w or e)
begin if(e==1)
case(w) 0: Y=4'b1000;
1: Y=4'b0100;
2: Y=4'b0010;
3: Y=4'b0001;
endcase
else
Y=4'b0000;
end
endmodule

module dec4to16(w,e,Y);
input [3:0]w;
input e;
output [0:15]Y;
wire[0:3]M;
dec2to4 dec1(w[3:2],e,M[0:3]);
dec2to4 dec2(w[1:0],M[0],Y[0:3]);
dec2to4 dec3(w[1:0],M[1],Y[4:7]);
dec2to4 dec4(w[1:0],M[2],Y[8:11]);
```

```
dec2to4 dec5(w[1:0],M[3],Y[12:15]);

endmodule
```

```
module q1(w, e, f, g, h);

input [3:0] w;

input e;

output f, g, h;

wire [0:15]Y;

dec4to16 dec1(w, e, Y);

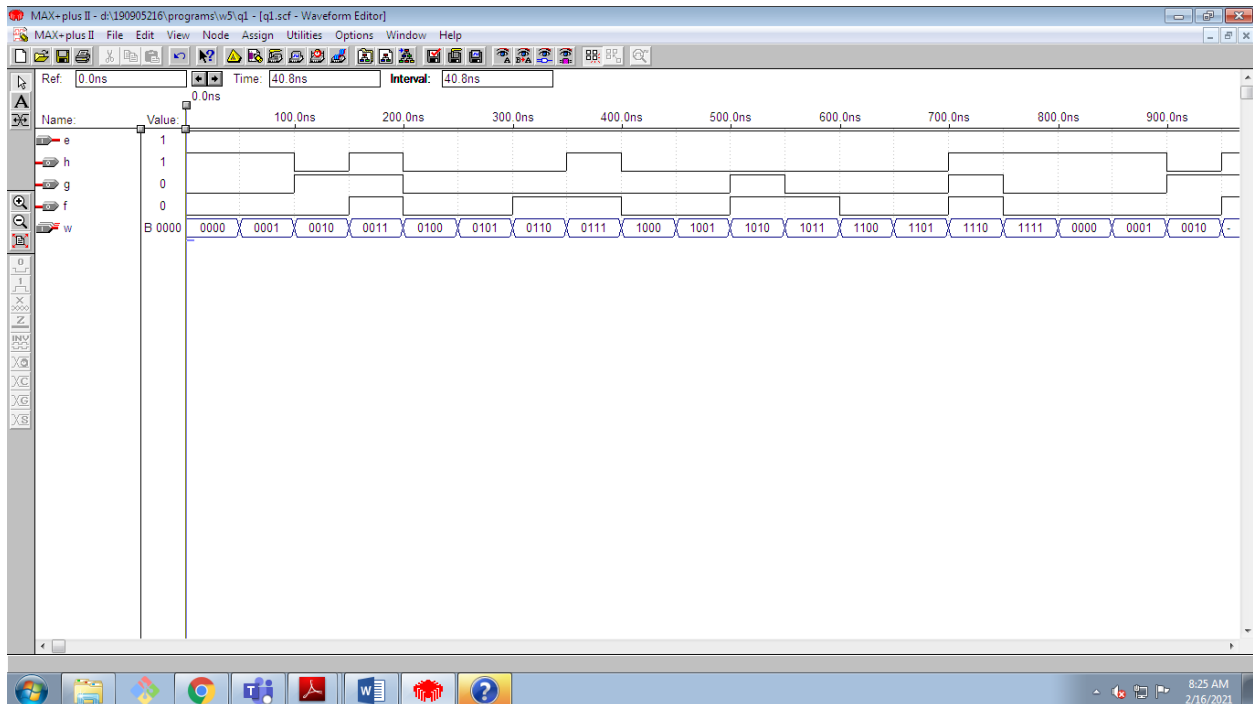
or(f, Y[3], Y[6], Y[7], Y[10], Y[11], Y[14]);

or(g, Y[2], Y[3], Y[10], Y[14]);

or(h, Y[0], Y[1], Y[3], Y[7], Y[14], Y[15]);

endmodule
```

Waveform:



Q2:

```
module dec2to4(W,e,Y);
input[1:0]W;
input e;
output [0:3]Y;
reg [0:3]Y;
always@(W or e)
begin
if(e==1)
case(W)
0: Y=4'b1000;
1: Y=4'b0100;
2: Y=4'b0010;
3: Y=4'b0001;
endcase
else
Y=4'b0000;
end
endmodule

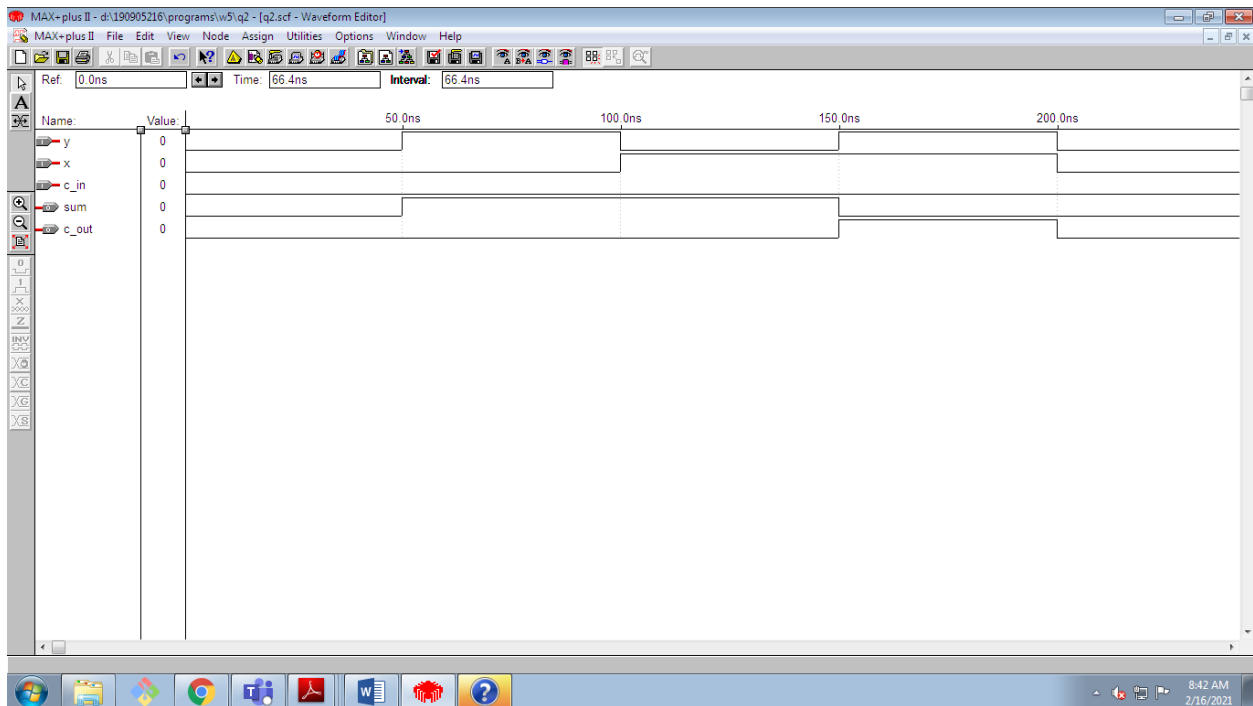
module q2(x, y, c_in, sum, c_out);
input x, y, c_in;
output sum, c_out;
wire [0:3] dec0w;
wire [0:3] dec1w;
wire [0:3] dec2w;
dec2to4 dec0({1'b0, x}, 1'b1, dec0w);
```

```

dec2to4 dec1({c_in, y}, dec0w[1], dec1w);
dec2to4 dec2({c_in, y}, dec0w[0], dec2w);
or(c_out, dec2w[3], dec1w[1], dec1w[2], dec1w[3]);
or(sum, dec2w[1], dec2w[2], dec1w[0], dec1w[3]);
endmodule

```

Waveform for Full adder using 2 to 4 decoder:



Q3:

```
module dec2to4(W,En,Y);
```

```
input[1:0]W;
```

```
input En;
```

```
output [0:3]Y;
```

```
reg [0:3]Y;
```

```
always@(W or En)
```

```
begin
```

```
if(En==1)
```

```
case(W)
```

```
0: Y=4'b1000;
```

```
1: Y=4'b0100;
```

```
2: Y=4'b0010;
```

```
3: Y=4'b0001;
```

```
endcase
```

```
else
```

```
Y=4'b0000;
```

```
end
```

```
endmodule
```

```
module dec3to8(W,En,Y);
```

```
input [2:0]W;
```

```
input En;
```

```
output [0:7]Y;
```

```
wire[0:3]M;
```

```
dec2to4 dec1({1'b0, W[2]},En,M);
```

```
dec2to4 dec2(W[1:0],M[0],Y[0:3]);
```

```
dec2to4 dec3(W[1:0],M[1],Y[4:7]);
```

```
endmodule
```

```
module q3(W, En, f, g, h);  
input [3:0] W;  
input En;  
output f, g, h;  
wire [0:7] temp0;  
wire [0:7] temp1;  
wire [0:7] temp2;  
wire [0:7] temp3;  
wire [0:7] temp4;  
dec3to8 dec0({1'b0, W[3], W[2]}, En, temp0);  
dec3to8 dec1({1'b0, W[1], W[0]}, temp0[0], temp1);  
dec3to8 dec2({1'b0, W[1], W[0]}, temp0[1], temp2);  
dec3to8 dec3({1'b0, W[1], W[0]}, temp0[2], temp3);  
dec3to8 dec4({1'b0, W[1], W[0]}, temp0[3], temp4);  
or(f, temp1[2], temp2[0], temp2[3], temp3[1]);  
or(g, temp1[0], temp1[3], temp4[3]);  
or(h, temp1[0], temp1[2], temp3[2], temp4[0]);  
endmodule
```

Waveform for f,g and h:

