EE314 Experiment 5 Flip-Flops and Sequential Circuits

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 $\begin{array}{c} 2018 \\ \mathrm{April} \end{array}$

1)

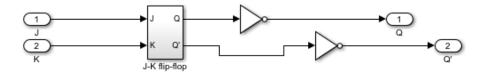


Figure 1: Logic design for Question 1

2)
$$Q_{1n} = JQ'_{1n-1} + K'Q_{1n-1}$$

$$J = Q'_{3n-1}Q'_{2n-1} \quad K = Q_{3n-1}Q_{2n-1}$$

$$K' = Q'_{3n-1} + Q'_{2n-1}$$

$$Q_{1n} = Q'_{3n-1}Q'_{2n-1}Q'_{1n-1} + (Q'_{3n-1} + Q'_{2n-1})Q_{1n-1}$$

$$Q_{2n} = JQ'_{2n-1} + K'Q_{2n-1}$$

$$J = Q_{1n} \quad K' = Q_{1n}$$

$$Q_{2n} = Q_{1n}Q'_{2n-1} + Q_{1n}Q_{2n-1}$$

$$Q_{2n} = 2Q_{3n-1}Q'_{2n-1}Q'_{1n-1} + Q'_{2n-1}Q_{1n-1} + Q_{2n-1}Q_{1n-1}Q'_{3n-1}$$

$$Q_{3n} = JQ_{3n-1} + KQ'_{3n-1}$$

$$J = Q_{2n} \quad K = Q_{2n}$$

$$Q_{3n} = 2Q_{3n-1}Q'_{2n-1}Q'_{1n-1} + Q_{3n-1}Q'_{2n-1}Q_{1n-1}$$
3)

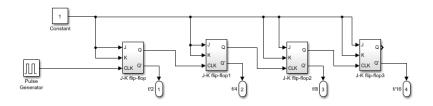


Figure 2: Frequency Converter Logic Design

4)

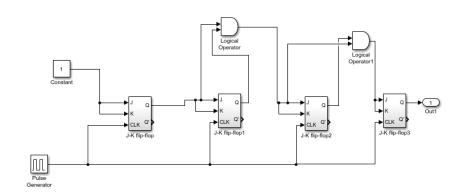


Figure 3: Ripple Up Counter

5)

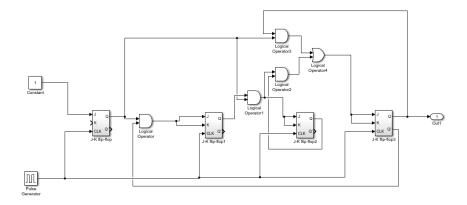


Figure 4: BCD counter

6)

```
module counter(clr,clk,dir, tc, q);
 input clr,clk,dir;
 output reg tc;
output reg[3:0] q;
always@(posedge clk,posedge clr)
⊟begin
if(clr==1)
 q=4'd0;
else
⊟begin
 if (dir==1)
 q=q+1;
 else if(dir==0)
 q=q-1;
 if(dir==1 & q==4'd10)
⊟begin
q=4'd0;tc=1'b1;
 end
else if(dir==0 & q==4'd15)
⊟begin
q=1'd9;tc=1'b1;
 end
else tc=1'b0;
-end
-end
 endmodule
```

Figure 5: Verilog Code



Figure 6: BCD counter Simulation results