1. (1pts) What is the Hamming distance between these two bit patterns: 1001 and 0101?

2. (3pts) How far apart must valid code words be to allow Single Error Detection (SED)?
Triple Error Correction (DEC)?
Quadruple (4) Error Correction Quintuple (5) Error Detection (QECQED)?

3. (3pts) Write the equation for the carry out of the 3rd adder cell in an ALU using carry-lookahead, in terms of P's and G's.

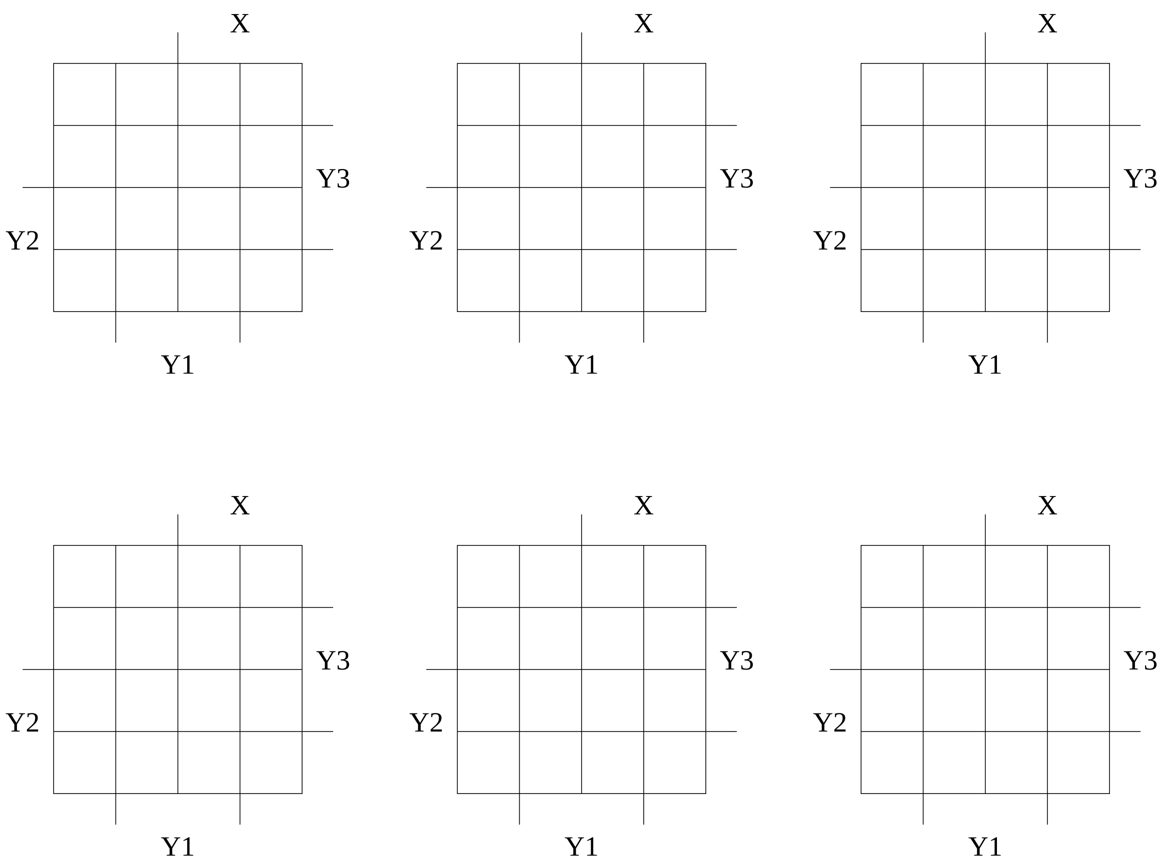
4. (3pts) What is the difference between the Mealy and Moore models of sequential design?

5. (10pts) We know that a single cell of a ripple carry adder implements the functions
$Cout = AB+AC_{in}+BC_{in}$
and
$Sum = A \text{ xor } B \text{ xor } Cin$
Assuming you have made a 3-bit ripple carry adder using these cells, what is the worst case path through the adder? In other words, how long does it take for the answer to be correct in all cases? (I suggest you draw the circuit in order to make doing this problem easier). Use the following delay values, and assume all input signals become valid at time 0:

2-input AND:	5 ns	2-input OR:	4 ns	2-input XOR:	8 ns
3-input AND:	6 ns	3-input OR:	7 ns	3-input XOR:	11 ns

6. (25pts) Given the following table, draw the Karnaugh maps for Y1’, Y2’, and Y3’ and Z in terms of X, Y1, Y2 and Y3, and then write **minimum** boolean equations for each.

Present State (Y1 Y2 Y3)	Next State		Output (Z)	
	X=0 (Y1’ Y2’ Y3’)	X=1 (Y1’ Y2’ Y3’)	X=0	X=1
0 0 1	0 1 1	0 1 1	1	1
0 1 0	1 0 1	1 1 1	0	0
0 1 1	1 1 1	1 1 1	1	1
1 0 0	1 0 0	1 1 0	0	0
1 0 1	1 0 1	1 1 0	1	0
1 1 0	0 0 0	0 1 0	0	0
1 1 1	0 0 1	0 1 1	1	1



7. (25 pts) Given the following Karnaugh maps, implement the sequential machine using an JK FF for Y1, an RS FF for Y2, and a Toggle FF for Y3. You do not need to draw the gates, but you do need to write down minimized input equations for each of the inputs of each of the Flip Flops in the circuit.

Y1’

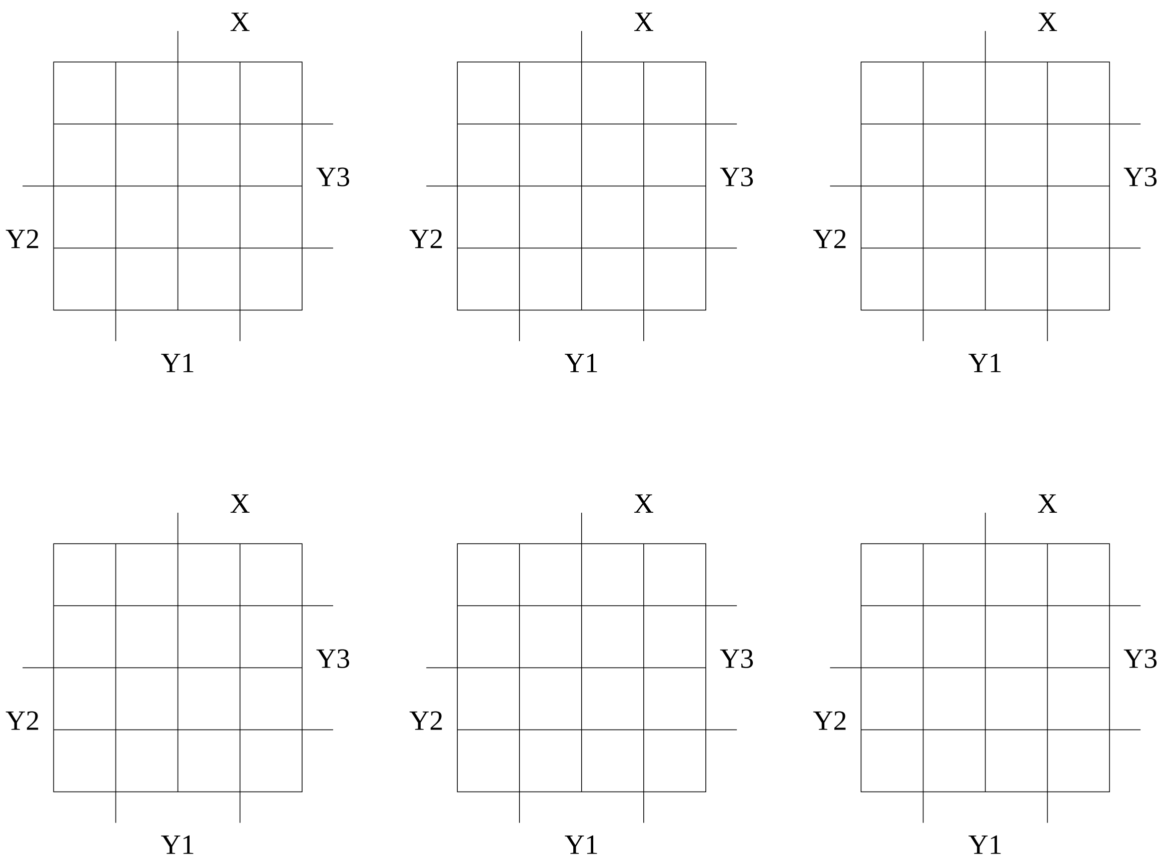
			X	X	
	1			1	
		1	1	d	Y3
Y2	1	d		1	Y3
Y2		1	1		
		Y1	Y1		

Y2’

			X	X	
	d				
	1	d	1	1	Y3
Y2			d		Y3
Y2	1	1	1	1	
		Y1	Y1		

Y3’

			X	X	
	1			1	
		1	1		Y3
Y2		1	1		Y3
Y2	1			1	
		Y1	Y1		



8. (30 pts) You have been (re)hired by the country of Freedonia to design a vending machine to dispense stamps. In Freedonia there are only two types of coins, the 25 Somolian piece and the 10 Somolian piece. Stamps cost 34 Somolians (just like they do here.) Your machine does not give change. Only one coin can be deposited at a time. Let X1=25 Somolians and X2=10 Somolains. Z=1 indicates the machine should dispense a stamp (1 bonus point for correctly identifying who is on the stamp! :-) Z=0 signals No Stamp.

Draw the State Transistion Diagram (the circles and the arcs) for this finite state machine. Let S0=nothing deposited (the Start state). Once you have a state transition diagram, minimize the number of states necessary and then assign bit patterns to each state and write down the corresponding state transition table. Assume you are using a Mealy model. Label the transitions on the diagram using the following format:

$$\frac{X1\,X2}{Z}$$

So, for example,

$$\frac{0\ 1}{0}$$

would be used to indicate that a 10 Somolian piece was deposited, and the output at that point should be a 0.