1. (1pts) What is the Hamming distance between these two bit patterns: 1101 and 0110?

2. (2pts) 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.

3. (4pts) Given the choice between 6-bit carry lookahead and 6-bit carry lookahead with group size of 3 and ripple carry between groups, which is faster? Which is more expensive and why?

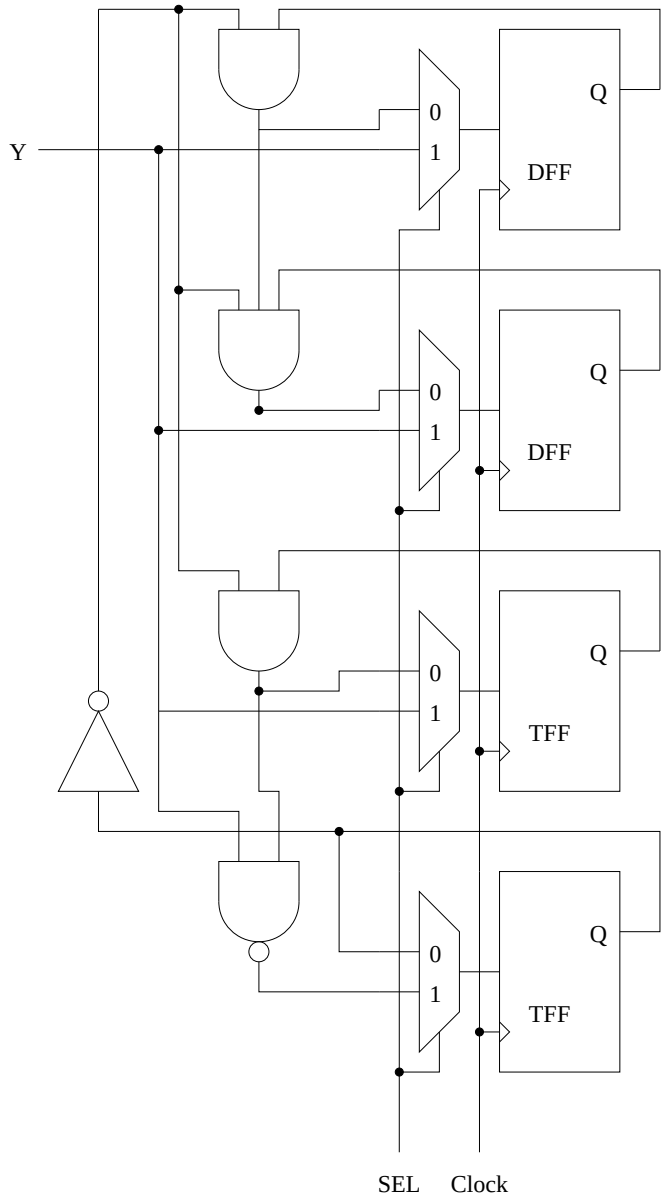
4. (3pts) What is the difference between the Mealy and Moore models of sequential design?

5. (3pts) What is the difference between a Flip-Flop and a latch?

6. (2 pts) What is a Karnaugh Map?

7. (10 pts) Assuming rising edge-triggered flipflops, what is the maximum clock frequency possible for the following circuit? (In other words, what is the maximum clock frequency that will still guarantee correct behavior?) Use the following delay values, and assume all input signals become valid at time 0. (Tprop is the propagation time for the flipflop, the time it takes from the rising edge of the clock until the output of the FF is valid.)

AND: 3ns NAND: 4ns NOT: 2ns MUX: 6ns
Tprop (DFF): 8ns Tsetup (DFF): 2ns Thold (DFF): 1ns
Tprop (TFF): 10ns Tsetup (TFF): 4ns Thold (TFF): 1ns



8. (3pts) How far apart must valid code words be to allow Double Error Detection (DED)?
Triple Error Correction (TEC)?
Quadruple (4) Error Correction quintuple (5) Error Detection (QECQED)?

9. (12 pts) Here is a 12-bit Error Correction code format (same one used in class):

$$d_8 \;\; d_7 \;\; d_6 \;\; d_5 \;\; C_4 \;\; d_4 \;\; d_3 \;\; d_2 \;\; C_3 \;\; d_1 \;\; C_2 \;\; C_1$$

a. Given the *data* bit pattern

1 0 1 1 0 1 0 0

in a machine using the above ECC code, what bit pattern gets sent to memory? (No credit will be given without work being shown.)

b. In this same machine, the following bit pattern is retrieved from memory:

0 0 1 0 1 1 1 0 1 0 0 1

Assuming the above Error Correction code format, identify and correct any errors that may have occurred during transmission or storage. (No credit will be given without work being shown.)

10. (5 pts) You have derived the following karnaugh maps for the inputs to an SR flip-flop. Unfortunately, the parts department just called and your company is completely out of SR flip-flops. All they have left in stock is T flip-flops, which you will have to use instead. Show the resulting karnaugh map for the modified version of the circuit (the one that uses the T instead of the SR flip-flop.) You do **not** have to write down the minimized equation.

S'

Y2 \ X,Y1	00	01	11	10
00		d		
01				1
11	d	d	d	d
10		d	d	1

Y3

R'

Y2 \ X,Y1	00	01	11	10
00	d			d
01	d		1	
11	d	d	d	d
10	d	1		d

Y3

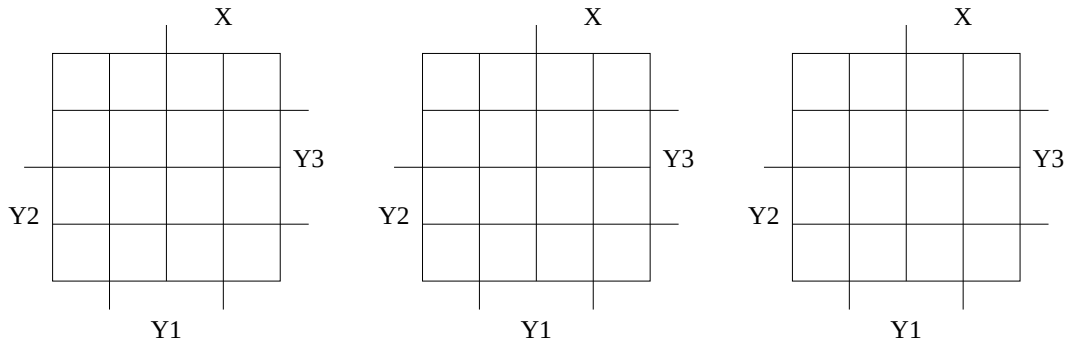
T'

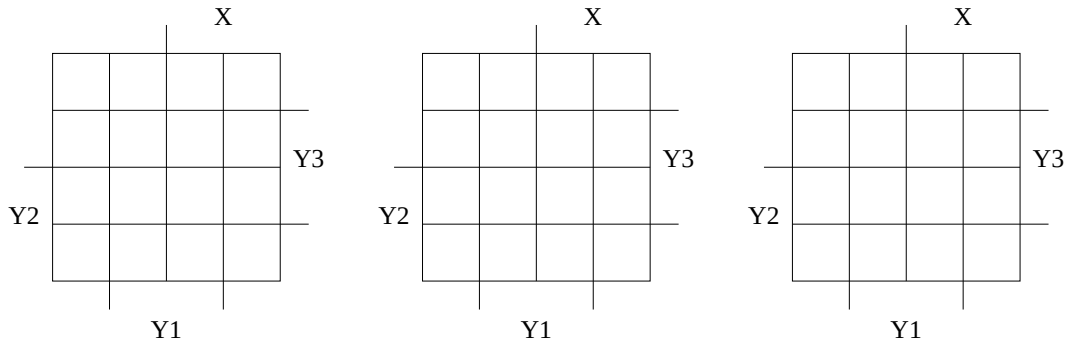
Y2 \ X,Y1	00	01	11	10
00				
01				
11				
10				

Y3

11. (20) 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 X=0 (Y1' Y2' Y3')	Next State X=1 (Y1' Y2' Y3')	Output X=0	Output X=1
000	111	011	0	0
010	101	001	0	1
011	100	000	0	1
100	001	001	0	0
101	000	000	1	1
110	100	000	0	1
111	100	000	1	1





12. (15 pts) Given the following Karnaugh maps, implement the sequential machine using a JK FF for Y1, an SR FF for Y2, and a T FF for Y3. You do not need to draw the gates, but you do need to write down the **minimized** input equations for each of the inputs of each of the Flip Flops in the circuit.

Y1'

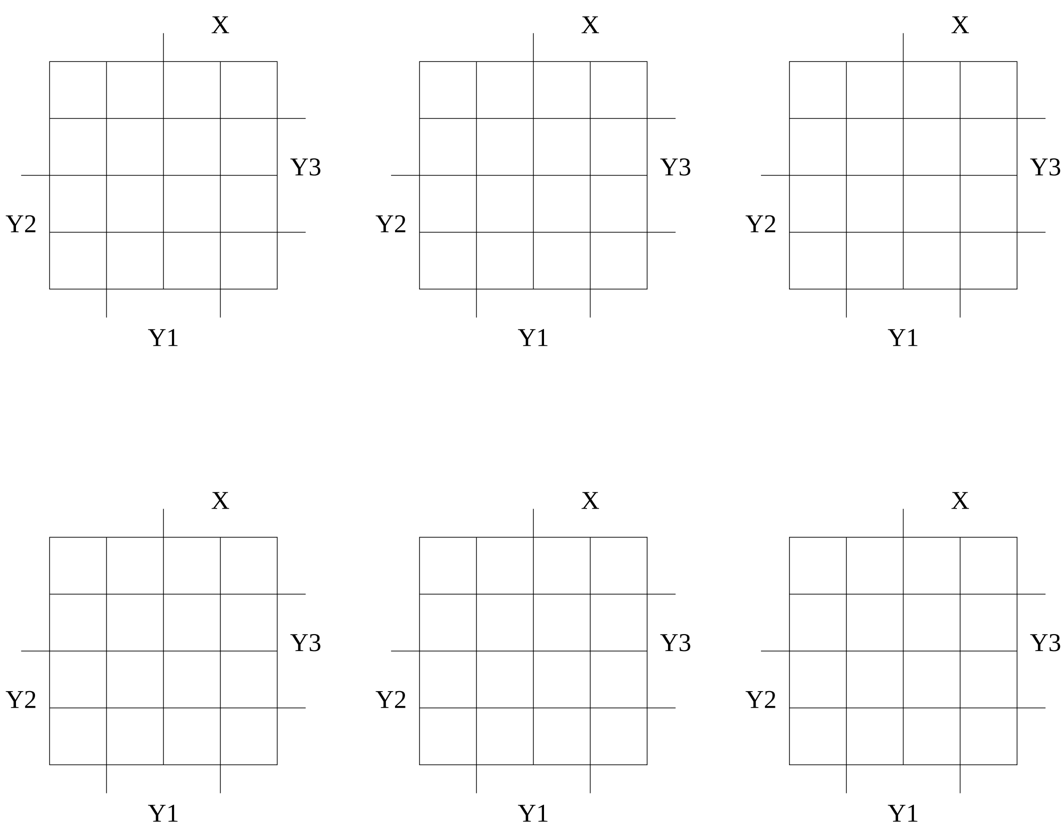
			X	X
	1		1	d
Y3		1	1	
Y3, Y2		1	1	1
Y2			1	d
		Y1	Y1	

Y2'

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

Y3'

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



13. (20 pts) The President of Freedonia, Rufus T. Firefly, has a sore back from carrying around all his money. He wants to get one of those vibrating chairs he saw at the mall, but he's too cheap to actually pay for one. Instead, he has hired you to modify his existing recliner and add the vibrating capability to it. Users have to pay, though, because he doesn't want his Prime Minister sneaking in and sitting in it constantly. He wants the chair to accept two coins, the 10 Quatloo piece (the "dimequat") and the 30 Quatloo piece. Each 5-minute vibrating session costs 40 Quatloos. The chair must give change, because the President is a cheapskate. Let X1=30 Quatloo coin and X2=10 Quatloo coin, and assume both coins cannot be inserted simultaneously. Also assume that if you are stupid enough to put in 3 dimequats and then a 30 Quatloo piece, or two 30 Quatloo pieces in a row, you will pay a 10 Quatloo penalty and only get 1 dimequat back (because the President has the key to the change box on the chair anyway.)

    Draw the State Transistion Diagram (the circles and the arcs) for this finite state machine. Let S0=no money input (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 format we used in class (inputs over outputs).