(b) -13 = 10011

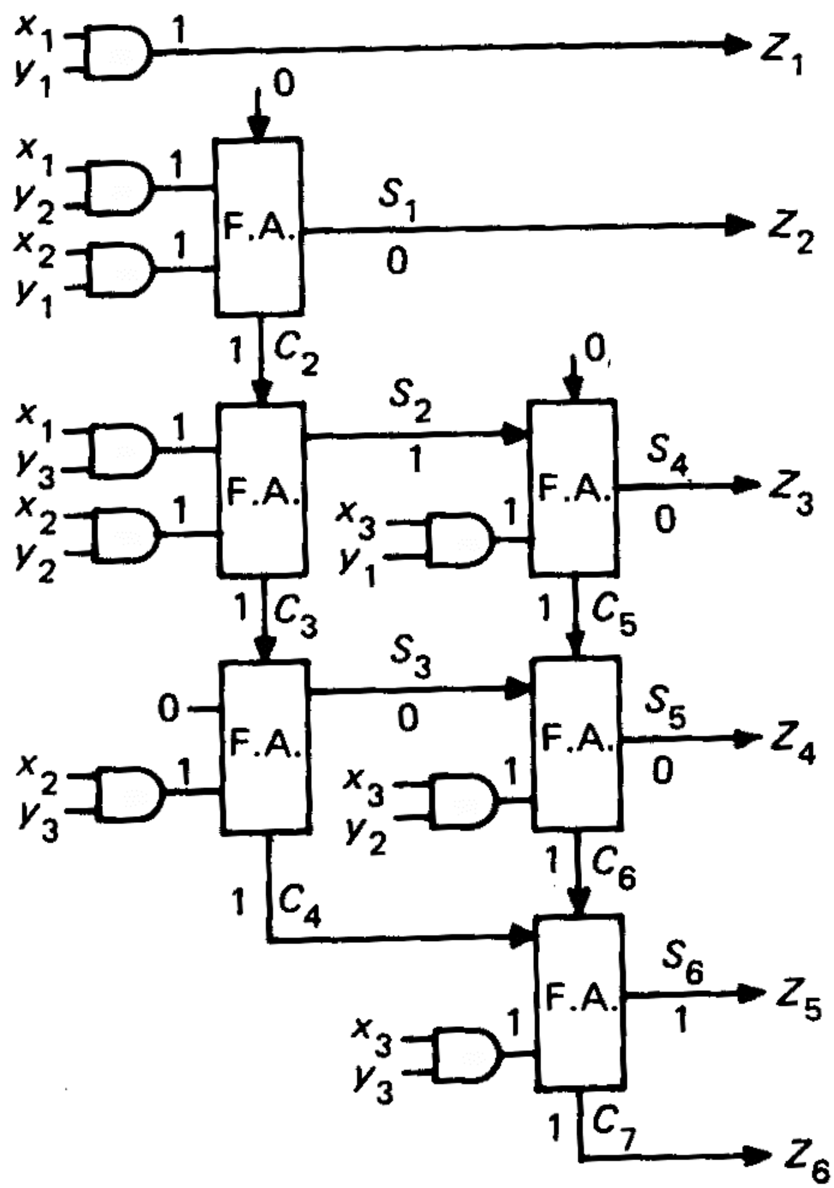
(c) 31 =   not possible with 5 bits

J3 = 0, K3 = X', Z = XQ3

(3) Design a parallel binary multiplier which multiplies two 3-bit binary numbers to for a 6-bit product. This multiplier is to be a combinational network consisting of an array of 1-bit full adders and AND gates only (no flip-flops).

(a) Show a schematic diagram.(*Hint:* The AND gates can be used to multiply by 0 or 1 and the full adders can be used to add 2 bits plus a carry. Six full adders are required.)

(b) Demonstrate you multiplier works by showing the values on all internal outputs (outputs of adders and outputs of AND gates) when multiplying 111 by 111.



(c) Using exactly 5 bits, express the following numbers in 2's-complement form:

(a) 12 = 01100

(2) The following state table is to be implemented using J-K flip-flops and logic gates (format of next-state entries is (next-state,output)).

Present State	input x=0	input x=1
a	a,0	e,0
b	c,0	b,1
c	a,0	f,0
d	c,0	b,1
e	f,0	e,0
f	a,0	f,0

(a) Find a good state assignments using the three guidelines mentioned in class. (Do *not* reduce the table first). Try to satisfy as many of the adjacency conditions as possible.

Adjacency conditions:

Rule 1: "States which have the same next-state for a given input should be given adjacent assignments."

{f, c}, {d, b},

Rule 2: "States which are the next-states of the same states should be given adjacent assignments."

2*{a, f}, 2*{c, b}, {e, f}, {a, e}

Output: "States which have the same output for a given input should be given adjacent assignments."

Not of any value in this case; one input & one output almost everything would need to be adjacent! Lowest priority anyway.

The following assignment satisfies all of the adjacency conditions except {e,f}:

Q3 \ Q1Q2	00	01	11	10
0	A 0	F 2	C 6	E 4
1	1	3	B 7	D 5

(b) Using this assignment, derive the.J-K flip-flop input equations and output equations. Express them in a form that contains the minimum number of literals.

$J1 = XQ2'$, $K1 = Q2Q3' + XQ3'$, $J2 = X'Q1 + Q3$, $K2 = X'Q3'$

Quiz 2
Solutions

(Open Wakerly, Calculators OK, 1hr 20min)

Include all final answers in locations indicated on these pages. Use reverse side of sheets for all working. If necessary, attach additional sheets by staple at the end. BE SURE TO WRITE YOUR NAME ON EVERY SHEET.

(1) A sequential network has one input and one output. The output becomes 1 and remains 1 thereafter when at least two zeros and at least two ones have occurred as inputs, regardless of the order of occurrence. Draw a state graph (Moore type) for the network (9 states are sufficient). Your final state graph should be neatly drawn with no crossed lines.