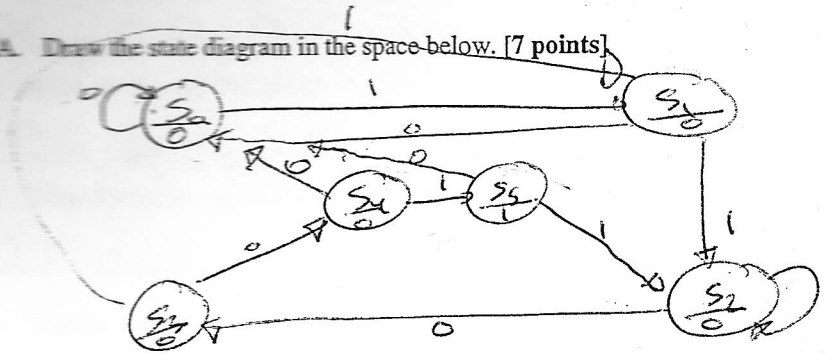


Problem 1: [10 points] 10

Using a Moore machine with D Flip-Flops, design a sequence detector that would output a Z=1 only after detecting the sequence 1001 on its single input X. Call the states S0, S1 etc. (use don't cares for illegal states and use simplest state assignment)

A. Draw the state diagram in the space below. [7 points]



B. Fill as much as needed in the corresponding state and transition tables shown below.

S	X		Z
	0	1	
S0	S0	S1	0
S1	S0	S2	0
S2	S3	S2	0
S3	S4	S1	0
S4	S0	S2	1
S5	S0	S2	1
	S*		

Q1Q2Q3	X		Z
	0	1	
000	000	001	0
001	000	010	0
010	011	010	0
011	100	001	0
100	000	101	0
101	000	010	1
<del>110</del>	<del>000</del>	<del>010</del>	<del>1</del>
	D1, D2, D3		

C. The excitation equations are given by: [3 points]

Q3X	Q1Q2			
	00	01	11	10
00	0	0	d	0
01	0	0	d	1
11	0	0	d	0
10	0	1	d	0

$$D1 = \frac{Q_1 Q_3' X}{+ Q_2 Q_3 X'}$$

Q3X	Q1Q2			
	00	01	11	10
00	0	1	d	0
01	0	1	d	0
11	1	0	d	1
10	0	0	d	0

$$D2 = \frac{Q_2' Q_3 X}{+ Q_2 Q_3'}$$

Q3X	Q1Q2			
	00	01	11	10
00	0	1	d	0
01	1	0	d	1
11	0	1	d	0
10	0	0	d	0

$$D3 = \frac{Q_2' Q_3' X}{+ Q_2 Q_3 X + Q_2 Q_3'}$$

**Problem 2: [10 points]**

Consider the function:  $F = \Sigma_{A,B,C,D}(0, 2, 3, 5, 7, 8, 10, 11, 14, 15)$

a) What are the prime implicants of F? [2 points]

~~$AC, CD, B'C, A'BD, B'C'D, A'B'D, A'B'D$~~

b) What are the essential prime implicants of F? [2 points]

~~$AC, CD, B'C, A'BD, B'D'$~~

c) What is a minimum SOP expression for F? [3 points]

~~$AC + CD + B'C + A'BD + B'D'$~~

d) What is a minimum POS expression for F? [3 points]

~~$(B'+C+D) \cdot (A'+C+D) \cdot (B+C+D) \cdot (A+B'+D)$~~   
 ~~$(A'+B'+C)$~~

ess. we look at (1) if its neighbors can go all together then it's ess.

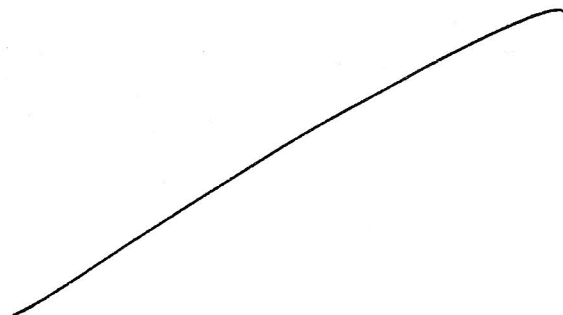
prime

	AB			
CD	00	01	11	10
00	1	0	1	1
01	1	1	0	0
11	1	1	1	1
10	1	0	1	1

**Problem 3: [10 points]**

Consider the Boolean function  $F = \Sigma_{A,B,C,D}(1, 3, 4, 11, 12, 13, 14, 15)$ .

a) Implement F using a 4-input multiplexer and external gates. Connect A and B to the select lines. [5 points]



b) Implement F using two 3-to-8 decoders with enables, an inverter and OR gates with maximum inputs of 4. [5 points]

