Name: SOLUTIONS

Read each question carefully before answering. Answer all parts. Show all work, calculations, and/or reasoning, otherwise no points will be awarded. Properly labeled loops must be shown on K-maps. Point values are as indicated.

1. (25 points) Design a Mealy Machine that generates an even parity bit (Z) for the 3 preceding bits of input (X). An example sequence of inputs and outputs are given below. Define all of the states and derive a reduced state table. (There are exactly enough rows on the state table template that is given below.)

$X=$	0	0	1	1	0	1	1	0	0	1	0	1	0	1	0	0	1	1	1	1
$Z=$	0	0	1	0	0	0	0	0	1	1	1	0	1	0	1	1	1	0	1	1

S_0 reset
A 0
B 1
C 00
D 01
E 10
F 11

Current State	Next State $X=0$	Next State $X=1$	Output $X=0$	Output $X=1$
S_0	A	B	0	0
A	C	D	0	0
B	E	F	0	0
C	C	D	0	1
D	E	F	1	0
E	C	D	1	0
F	E	F	0	1

2. Your buddy (who may or may not be any good at digital systems) gives you the following state table...

Current State	Next State		Output	
	$X = 0$	$X = 1$	$X = 0$	$X = 1$
A	F	B	0	0
B	E	A	0	1
C	H	G	0	1
D	H	D	1	0
E	B	F	1	1
F	G	B	0	0
G	A	C	0	0
H	C	A	1	1

(a) (5 points) Is this a Mealy machine or a Moore machine? Explain how you know.

MEALY – OUTPUTS DEPEND ON INPUT & CURRENT STATE

(b) (10 points) Use an implication table to reduce the number of states. Indicate which (if any) states are equivalent.

	A	B	C	D	E	F	G
B	X						
C	X	E-H A-G					
D	X	X	X				
E	X	X	X	X			
F	F-G	X	X	X	X		
G	F-A B-C	X	X	X	X	G-A B-C	
H	X	X	X	X	B-C F-A	X	X

A ≡ F ≡ G

B ≡ C

E ≡ H

3. (20 points) Determine if the two sequential circuits (given below as state tables) are equivalent. Justify your answer.

C.S.	N.S.		YZ
	$X = 0$	$X = 1$	
A	B	D	00
B	D	B	01
C	C	B	11
D	A	C	10

C.S.	N.S.		YZ
	$X = 0$	$X = 1$	
S_0	S_2	S_4	00
S_1	S_1	S_2	11
S_2	S_4	S_5	01
S_3	S_5	S_4	00
S_4	S_3	S_1	10
S_5	S_4	S_2	01

	S_0	S_1	S_2	S_3	S_4	S_5
A	B-S2 D-S4	X	X	B-S5 D-S4	X	X
B	X	X	D-S4 B-S5	X	X	D-S4 B-S2
C	X	C-S1 ✓ B-S2	X	X	X	X
D	X	X	X	X	A-S3 C-S1	X

THEY ARE EQUIVALENT

$A \equiv S_0 \equiv S_3$

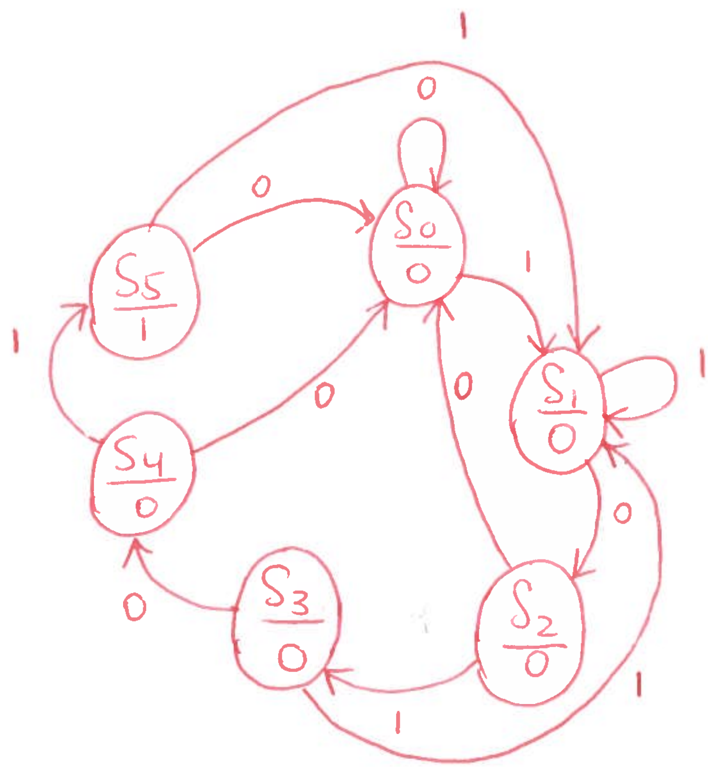
$B \equiv S_2 \equiv S_5$

$C \equiv S_1$

$D \equiv S_4$

4. (25 points) You wish to design a Moore machine non-overlapping sliding window detector that has an output $Z = 1$ when the input sequence contains **10101**. Clearly define all states that are required to implement this circuit, then draw the state diagram for this circuit.

S_0	reset , 0, 00...	$Z=0$
S_1	1, 11...	$Z=0$
S_2	10	$Z=0$
S_3	101	$Z=0$
S_4	1010	$Z=0$
S_5	10101	$Z=1$



5. The following is a fully reduced state table.

Current State	Next State $X=0$	Next State $X=1$	Output
A	A	B	0
B	C	B	0
C	D	E	0
D	A	B	1
E	F	B	0
F	D	E	1

(a) (5 points) How many flip-flops will you need to implement this circuit?

3 FLIP-FLOPS

(b) (5 points) Implement the guidelines for state assignment.

Guideline 1:

AD ✓

CF x2 ✓

ABDE

Guideline 2:

AB x2 ✓

CB ✓

DE x2 ✓

FB

Guideline 3:

ABCE

DF

(c) (5 points) Use a K-map to determine state assignments for each state. Indicate the binary values for each state.

C \ AB	00	01	11	10
0	C	B	E	X
1	F	A	D	X

A = 011

B = 010

C = 000

D = 111

E = 110

(d) (10 points) Fill out the corresponding transition table.

Current State		Next State $X=0$			Next State $X=1$			Output (Z)
C	000	1	1	1	1	1	0	0
F	001	1	1	1	1	1	0	1
A	011	0	1	1	0	1	0	0
B	010	0	0	0	0	1	0	0
	100	X	X	X	X	X	X	X
	101	X	X	X	X	X	X	X
D	111	0	1	1	0	1	0	1
E	110	0	0	1	0	1	0	0