ECE27000

PRACTICE10 SOLUTIONS

1)

Meaning	S	S^*, Z X = 0	X=1
-	A	A, 0	B, 0
Sequence detected: 1	B	A, 0	C, 0
Sequence detected: 11	C	A, 0	D, 0
Sequence detected: 111	D	A, 0	D, 1

2)

Meaning	S	S^*, Z X = 0	X=1
-	A	A, 0	B, 0
Starts with 1	B	A, 0	C, 0
Starts with 11	C	D, 0	E, 0
Starts with 110	D	F, 0	G, 0
Starts with 111	E	G, 0	H, 0
Starts with 1100	F	A, 0	I, 1
Starts with 1101 / 1110	G	I, 1	A, 0
Starts with 11, contains more than 3 ones	H	A, 0	A, 0
Starts with 11, contains exactly 3 ones	I	A, 0	B, 0

3)

Sequence detector to detector - 0000, 0011, 0110, 1001, 1100, 1111 (overlapping)

Meaning	Present State	Next state, Output	
		X = 0	X = 1
Start	S0	S10,0	S11,0
0	S10	S20,0	S21,0
1	S11	S22,0	S23,0
00	S20	S30,0	S31,0
01	S21	S32,0	S33,0
10	S22	S34,0	S35,0
11	S23	S36,0	S37,0
000	S30	S30,1	S31,0
001	S31	S32,0	S33,1
010	S32	S34,0	S35,0
011	S33	S36,1	S37,0
100	S34	S30,0	S31,1
101	S35	S32,0	S33,0
110	S36	S34,1	S35,0
111	S37	S36,0	S37,1

Non-overlapping:

Meaning	Present State	Next state, Output		Weight
		X = 0	X = 1	
Start	A	B,0	D,0	8%3 = 2
n%3 = 0 X_ _ _	B	E,0	F,0	4%3 = 1

n%3 = 1 X_ _ _	C			
n%3 = 2 X_ _ _	D	G,0	E,0	
n%3 = 0 XX _ _	E	H,0	J,0	2%3 = 2
n%3 = 1 XX_ _	F	I,0	H,0	
n%3 = 2 XX_ _	G	J,0	I,0	
n%3 = 0 XXX_	H	A,1	A,0	1%3 = 1
n%3 = 1 XXX_	I	A,0	A,0	
n%3 = 2 XXX_	J	A,0	A,1	

4)

S	S*,Z	
	X=0	X=1
A	B,1	H,1
B	F,1	D,1
C	D,0	E,1
D	C,0	F,1
E	D,1	C,1
F	C,1	C,1
G	C,1	D,1
H	C,0	A,1

P0 = (ABCDEFGH)

To perform state minimization, we first separate the states based on the outputs for a 1 bit input.

For X=1, all outputs are same.

For X=0, outputs are 1 for ABEFG and 0 for CDH.

Hence, P1 = (ABEFG)(CDH)

P2:

X=0 : **ABEFG => BFDCC**

CDH => DCC

X=1: ABEFG => HDCCD

CDH => EFA

Since BF and CD are in separate set of states, we can separate AB from EFG

Thus P2 = (AB)(EFG)(CDH)

P3:

X=0 : **AB => BF**

EFG => DCC

CDH => DCC

X=1: AB => HD

EFG => CCD

CDH => EFA

Since AB and EF belong to separate set of states, we can separate A from B and H from CD.

Thus P3 = (A)(B)(EFG)(CD)(H)

P4:

X=0 : A => B

B => F

EFG => DCC

CD => DC

H => C

X=1: A => H

B => D

EFG => CCD

CD => EF

H => A

No further separation possible.

Hence, P4 = P3 = (A)(B)(EFG)(CD)(H)

State table after minimization:

S	S*,Z	
	X=0	X=1
A	B,1	H,1
B	E,1	C,1
C	C,0	E,1
E	C,1	C,1
H	C,0	A,1

5)

Combining the two state tables through direct sum:

S	S*,Z	
	X=0	X=1
A	A,0	B,1
B	A,0	C,0
C	C,0	A,1
a	a,0	c,1
b	b,0	a,1
c	a,0	b,0

Now performing state minimization:

P0 = (ABCabc)

For X=0, all outputs are same.

For X=1, outputs are 1 for ACab and 0 for Bc.

Hence, P1 = (ACab)(Bc)

P2:

X=0 : ACab => ACab

Bc => Aa

X=1: **ACab => BAca**

Bc => Cb

Since Bc and Aa are in separate set of states, we can separate Aa from Cb

Thus P2 = (Aa)(Cb)(Bc)

P3:

X=0 : Aa => Aa

Cb => Cb

Bc => Aa

X=1: Aa => Bc

Cb => Aa

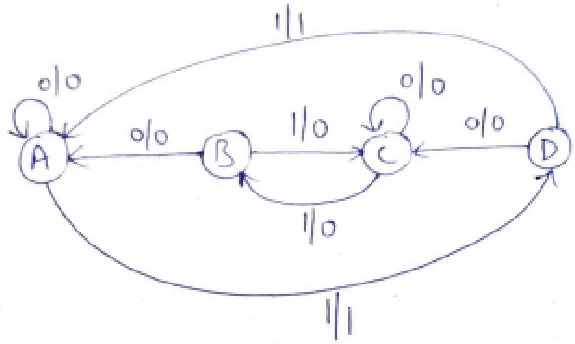
Bc => Cb

No further minimization

Thus P3 = (Aa)(Cb)(Bc)

After state minimization, since A is equivalent to a, C is equivalent to b, and B is equivalent to c. The two state machines are equivalent

6)



Characteristic table :-

Present state $Q_0 Q_1$	Input X	Next state $Q_0^* Q_1^*$	output (X^*)
A (00)	0	A (00)	0
B (01)	0	A (00)	0
C (10)	0	C (10)	0
D (11)	0	C (10)	0
A (00)	1	D (11)	1
B (01)	1	C (10)	0
C (10)	1	B (01)	0
D (11)	1	A (00)	1

Q_0^*

$Q_0 \backslash Q_1X$	00	01	11	10
0	0	1	1	0
1	1	0	0	1

$Q_0^* = \bar{Q}_0 X + Q_0 \bar{X}$

Q_1^*

$Q_0 \backslash Q_1X$	00	01	11	10
0	0	1	0	0
1	0	1	0	0

$Q_1^* = \bar{Q}_1 X$

X^*

$Q_0 \backslash Q_1X$	00	01	11	10
0	0	1	0	0
1	0	0	1	0

$X^* = \bar{Q}_0 \bar{Q}_1 X + Q_0 Q_1 X$