Morris- Mano
Chap-6 Art.6.7
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Design Procedure Using Sequential Circuit:

- Problem Description or State Diagram
- State Table
- State Reduction
- Assign Binary values to each state in state table
- Determine Number of flip-flops and assign a letter symbol to each
- Choose type of flip-flop to used
- From state table, derive Excitation table and Output table.

Book: Floyd

Design with Unused States:

A circuit with m-flip flops has 2^m states.
When simplifying Input functions to flip-flops, the unused states can be treated as Don't Care Conditions.

State Reduction:

If 2 states have same input and output, they're are equivalent states.
01 of the equivalent states can be reduced.

pdf [pg-224] Example

[pg-228] Example

↳ If goes to unused state, needs to be sent to used state

↳ Loop cannot be allowed to occur

Flip-Flop : S-R X

D - FlipFlop ✓

T- Flip Flop ✓

3-bit Gray Code Counter

① State Diagram

② State Table

Present State C	B	A	Next State C	B	A
0	0	0	0	0	1
0	0	1	0	1	1
0	1	1	0	1	0
0	1	0	1	1	0
1	1	0	1	1	1
1	1	1	1	0	1
1	0	1	1	0	0
1	0	0	0	0	0

In Book, JK Flip Flop Used

③ Flip-Flop Transition Table / Excitation Table

Present State			Next State			D Flip-Flop		
C	B	A	C	B	A	E_C	E_B	E_A
0	0	0	0	0	1	0	0	1
0	0	1	0	1	1	0	1	1
0	1	1	0	1	0	0	1	0
0	1	0	1	1	0	1	1	0
1	1	0	1	1	1	1	1	1
1	1	1	1	0	1	1	0	1
1	0	1	1	0	0	1	0	0
1	0	0	0	0	0	0	0	0

④ K-Maps

E_C

	$\bar{B}\bar{A}$	$\bar{B}A$	BA	$B\bar{A}$
$\bar{C}$	0	0	0	1
C	0	1	1	1

→ $B\bar{A}$

→ CA

$E_C = B\bar{A} + CA$

E_B

	$\bar{B}\bar{A}$	$\bar{B}A$	BA	$B\bar{A}$
$\bar{C}$	0	1	1	1
C	0	0	0	1

$E_B = \bar{C}A + B\bar{A}$

E_A

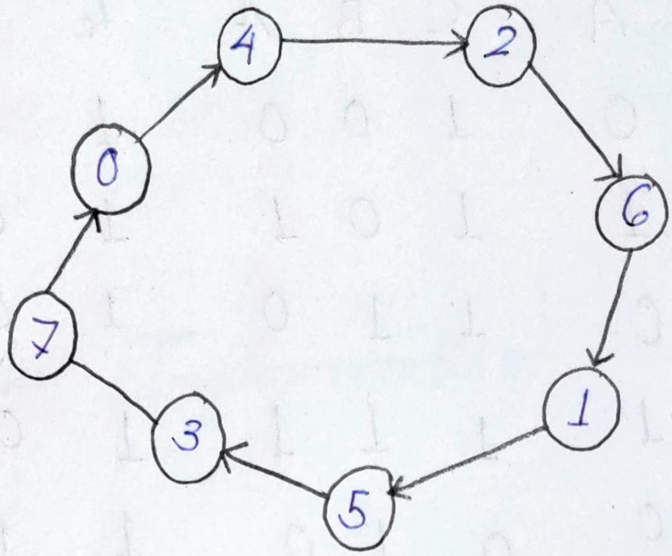
	$\bar{B}\bar{A}$	$\bar{B}A$	BA	$B\bar{A}$
$\bar{C}$	1	1	0	0
C	0	0	1	1

$E_A = \bar{C}\bar{B} + CB$

⑤ Logic Expressions for Inputs

⑥ Counter Implementation

State Diagram



State Table:

	Present State				Next State		
	C	B	A		C	B	A
0	0	0	0	4	1	0	0
1	0	0	1	5	1	0	1
2	0	1	0	6	1	1	0
3	0	1	1	7	1	1	1
4	1	0	0	2	0	1	0
5	1	0	1	3	0	1	1
6	1	1	0	1	0	0	1
7	1	1	1	0	0	0	0

③ Flip Flop Transition Table / Excitation Table

Present State			Next State			T-Flip Flop		
C	B	A	C	B	A	T_C	T_B	T_A
0	0	0	1	0	0	1	0	0
0	0	1	1	0	1	1	0	0
0	1	0	1	1	0	1	0	0
0	1	1	1	1	1	1	0	0
1	0	0	0	1	0	1	1	0
1	0	1	0	1	1	1	1	0
1	1	0	0	0	1	1	1	1
1	1	1	0	0	0	1	1	1

④ K-Maps:

C \ BA				
$\overline{C}$				
C				

$T_C = 1$

C \ BA				
$\overline{C}$	0	0	0	0
C	1	1	1	1

$T_B = C$

C \ BA	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{C}$	0	0	0	0
C	0	0	1	1

$T_A = CB$

⑤ Logic Expressions for Inputs:

⑥ Counter Implementation: