

# Model Answer

Indian Institute of Technology Guwahati, Deptt. of Comp. Sc. & Engg.

CS221 (Digital Design) Quiz B2, Time: 50 minutes, Marks: 20 Date: 30th Oct 2019

Name:	Roll No:
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Write answer in the space provided. Draw diagram for FSM if asked.

Q1: [2+2+2 Marks] Design a counter using J-K FFs which count in the following sequence: [1, 4, 7, 2, 1, 4, 7, 2, ....]. Also ensure that your designed counter do not get stuck in invalid states. Draw FSM of your counters and write final Boolean functions for inputs to the J-K FFs and any others functions.

FSM Diagram:

```

    graph LR
      A((A)) -- 00 --> B((B))
      B -- 01 --> C((C))
      C -- 10 --> D((D))
      D -- 11 --> A
  
```

State Table:

PS	NS	JA	KA	JB	KB
00	01	0	X	1	X
01	10	1	X	X	1
10	11	X	0	1	X
11	00	X	1	X	1

Boolean Functions:

$$J_A = B, K_A = B, J_B = 1, K_B = 1$$

Output Z:

PS	Z
00	1
01	4
10	7
11	2

Logic Diagram:

JK Flip-Flops for A and B. J and K inputs are connected to B. Output Z is the XOR of A and B.

Q2: [2+4 Marks] Minimize following state table using (a) Row Matching and (b) Partitioning Method.

PS	NS,Z	
	X=0	X=1
A	E,0	D,1
B	F,0	D,0
C	E,0	D,1
D	F,0	B,0
E	C,0	F,1
F	B,0	C,0

Using RM

(a) A & C state have NS & Z so they can be combined after that combination not possible

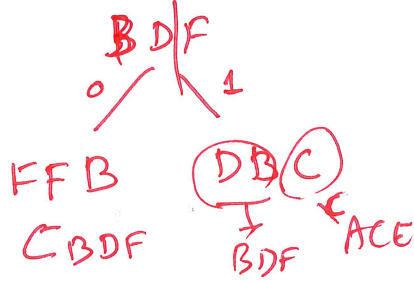
(b)

$$P_1 = (A B C D E F) \leftarrow \text{Boolean O/P}$$

$$P_2 = (A C E) (B D F)$$

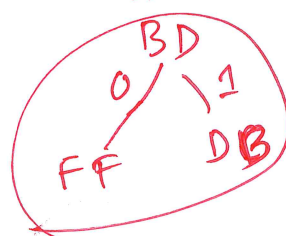
$$P_3 = (A C E) (B D) (F)$$

$$P_4 = (A C) (E) (B D) (F)$$



$$P_5 = (A C) (E) (B D) (F)$$

final Answer



Q3: [3+3+2 marks] Minimize the state table using Implication chart method. Fill the first marking pass Table, fill the subsequent markings in the Table, and write the final answer.

PS	NS,Z	
I/p ->	X=0	X=1
A	F,0	B,0
B	D,0	C,0
C	F,0	E,0
D	G,1	A,0
E	D,0	C,0
F	F,1	B,1
G	G,0	H,0
H	G,1	A,0

First pass ~~DFH~~  $\neq$  ABCEG, ~~F~~  $\neq$  ABCD, GH

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

First pass  $\Rightarrow$

Rem of the pass

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

Final Answer

A, C  $\Rightarrow$  are in  
B, E  $\Rightarrow$  are in  
D, H  $\Rightarrow$  are in

(A C) (B E) (D H) (F) (G)  
(AC) (BE) (DH) (F) (G)