

National Institute of Technology  
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Assignment:- 04

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Subject:- Information Technology

Topic:- Counter Design

Section:- SI3(B1)

Q) Design of a Synchronous 4-bit Even Up-Counter Using T-Type flip-flop for getting the following Sequence 0-2-4-6-8-10-12-14-0.

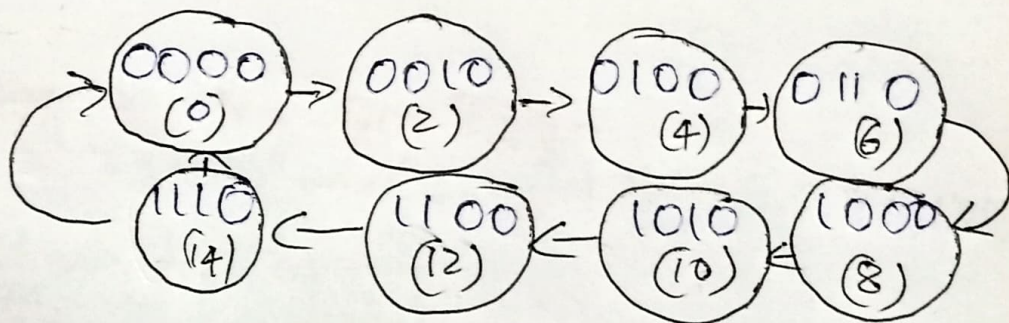
Truth Table :-

T	$Q_n$	$Q_{n+1}$
0	0	0
0	1	1
1	0	1
1	1	0

$Q_n$  - present state

$Q_{n+1}$  - Next State

State Diagram :-



Solving K-map for  $T_i$  :-

$Q_3 Q_2$ \ $Q_1 Q_0$	00	01	11	10
00	1 <sub>0</sub>	X <sub>1</sub>	X <sub>3</sub>	1 <sub>2</sub>
01	1 <sub>4</sub>	X <sub>5</sub>	X <sub>7</sub>	1 <sub>6</sub>
11	1 <sub>12</sub>	X <sub>13</sub>	X <sub>15</sub>	1 <sub>14</sub>
10	1 <sub>8</sub>	X <sub>9</sub>	X <sub>11</sub>	1 <sub>10</sub>

$$T_i = \sum m(0, 2, 4, 6, 8, 10, 12, 14) + \sum d(1, 3, 5, 7, 9, 11, 13, 15)$$

$$T_i = 1$$



## Solving K-Map for $T_0$ :-

$$T_0 = 0 + \sum d(1, 3, 5, 7, 9, 11, 13, 15)$$

$Q_3 Q_2 \backslash Q_1 Q_0$	00	01	11	10
00	0 <sub>0</sub>	X <sub>1</sub>	X <sub>3</sub>	0 <sub>2</sub>
01	0 <sub>4</sub>	X <sub>5</sub>	X <sub>7</sub>	0 <sub>6</sub>
11	0 <sub>12</sub>	X <sub>13</sub>	X <sub>15</sub>	0 <sub>14</sub>
10	0 <sub>8</sub>	X <sub>9</sub>	X <sub>11</sub>	0 <sub>10</sub>

$$T_0 = 0$$

Simplified Boolean Expression:-

$$T_0 = 0$$

$$T_1 = 1$$

$$T_2 = Q_1$$

$$T_3 = Q_2 Q_1$$

## Solving K-Map for $T_3$ :-

$$T_3 = \sum m(6, 14) + \sum d(1, 3, 5, 7, 9, 13, 15)$$

$Q_3 Q_2 \backslash Q_1 Q_0$	00	01	11	10
00	0 <sub>0</sub>	X <sub>1</sub>	X <sub>3</sub>	0 <sub>2</sub>
01	0 <sub>4</sub>	X <sub>5</sub>	X <sub>7</sub>	1 <sub>6</sub>
11	0 <sub>12</sub>	X <sub>13</sub>	X <sub>15</sub>	1 <sub>14</sub>
10	0 <sub>8</sub>	X <sub>9</sub>	X <sub>11</sub>	0 <sub>10</sub>

$$T_3 = Q_2 Q_1$$





