DESIGNING OF MOD 11 COUNTER USING JK FLIP FLOP

1. NO OF STATES = (7+4) = 11

SO, NO OF FFs REQUIRED => n >= LOG(N)

n = 4

1. EXCITATION TABLE FOR JK FF:

|  |  |  |  |
| --- | --- | --- | --- |
| PRESENT STATE | NEXT STATE | FLIPFLOP INPUTS | |
| Qn | Qn+1 | J | K |
| 0 | 0 | 0 | X |
| 0 | 1 | 1 | X |
| 1 | 0 | X | 1 |
| 1 | 1 | X | 0 |

1. STATE TABLE:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PRESENT INPUT | | | | NEXT INPUT | | | | FLIPFLOP INPUTS | | | | | | | |
| Qd | Qc | Qb | Qa | Qd+1 | Qc+1 | Qb+1 | Qa+1 | Jd | Kd | Jc | Kc | Jb | Kb | Ja | Ka |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | X | 0 | X | 0 | X | 1 | X |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | X | 0 | X | 1 | X | X | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | X | 0 | X | X | 0 | 1 | X |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | X | 1 | X | X | 1 | X | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | X | X | 0 | 0 | X | 1 | X |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | X | X | 0 | 1 | X | X | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | X | X | 0 | X | 0 | 1 | X |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | X | X | 1 | X | 1 | X | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | X | 0 | 0 | X | 0 | X | 1 | X |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | X | 0 | 0 | X | 1 | X | X | 1 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | X | 1 | 0 | X | X | 1 | 0 | X |
| 1 | 0 | 1 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 1 | 0 | 0 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 1 | 0 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 0 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |

Qb-Qa

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| X | X | X | X |
| X | X | X | X |

Qd-Qc

Jd = Qc . Qb . Qa

Qb-Qa

|  |  |  |  |
| --- | --- | --- | --- |
| X | X | X | X |
| X | X | X | X |
| X | X | X | X |
| 0 | 0 | X | 1 |

Qd-Qc

Kd = Qb

Qb-Qa

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | 0 | 1 | 0 |
| X | X | X | X |
| X | X | X | X |
| 0 | 0 | X | 0 |

Qd-Qc

Jc = Qa . Qb

Qb-Qa

|  |  |  |  |
| --- | --- | --- | --- |
| X | X | X | X |
| 0 | 0 | 1 | 0 |
| X | X | X | X |
| X | X | X | X |

Qd-Qc

Kc = Qa . Qb

Qb-Qa

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | 1 | X | X |
| 0 | 1 | X | X |
| X | X | X | X |
| 0 | 1 | X | X |

Qd-Qc

Jb = Qa

Qb-Qa

|  |  |  |  |
| --- | --- | --- | --- |
| X | X | 1 | 0 |
| X | X | 1 | 0 |
| X | X | X | X |
| X | X | X | 1 |

Qd-Qc

Kb = Qa + Qd

Qb-Qa

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | X | X | 1 |
| 1 | X | X | 1 |
| X | X | X | X |
| 1 | X | X | 0 |

Qd-Qc

Ja = Qb’ + Qd’ + Qc

Qb-Qa

|  |  |  |  |
| --- | --- | --- | --- |
| X | 1 | 1 | X |
| X | 1 | 1 | X |
| X | X | X | X |
| X | 1 | X | X |

Qd-Qc

Ka = 1

|  |  |  |  |
| --- | --- | --- | --- |
| PRESENT STATE | NEXT STATE | FLIPFLOP INPUTS | |
| Qn | Qn+1 | J | K |
| 0 | 0 | 0 | X |
| 0 | 1 | 1 | X |
| 1 | 0 | X | 1 |
| 1 | 1 | X | 0 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| M | PRESENT INPUT | | | | NEXT INPUT | | | | FLIPFLOP INPUTS | | | | | | | |
| Qd | Qc | Qb | Qa | Qd+1 | Qc+1 | Qb+1 | Qa+1 | Jd | Kd | Jc | Kc | Jb | Kb | Ja | Ka |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | X | 0 | X | 0 | X | 1 | X |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | X | 0 | X | 1 | X | X | 1 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | X | 0 | X | X | 0 | 1 | X |
| 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | X | 1 | X | X | 1 | X | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | X | X | 0 | 0 | X | 1 | X |
| 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | X | X | 0 | 1 | X | X | 1 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | X | X | 0 | X | 0 | 1 | X |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | X | X | 1 | X | 1 | X | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | X | 0 | 0 | X | 0 | X | 1 | X |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | X | 0 | 0 | X | 1 | X | X | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | X | 1 | 0 | X | X | 1 | 0 | X |
| 0 | 1 | 0 | 1 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |
| 0 | 1 | 1 | 0 | 0 | X | X | X | X | X | X | X | X | X | X | X | X |
| 0 | 1 | 1 | 0 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |
| 0 | 1 | 1 | 1 | 0 | X | X | X | X | X | X | X | X | X | X | X | X |
| 0 | 1 | 1 | 1 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | X | 0 | X | 1 | X | 0 | X |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | X | 0 | X | 0 | X | X | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | X | 0 | X | X | 1 | 1 | X |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | X | 0 | X | X | 0 | X | 1 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | X | X | 1 | 1 | X | 1 | X |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | X | X | 0 | 0 | X | X | 1 |
| 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | X | X | 0 | X | 1 | 1 | X |
| 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | X | X | 0 | X | 0 | X | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | X | 1 | 1 | X | 1 | X | 1 | X |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | X | 0 | 0 | X | 0 | X | X | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | X | 0 | 0 | X | X | 1 | 1 | X |
| 1 | 1 | 0 | 1 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 0 | 0 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 0 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 1 | 0 | X | X | X | X | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 1 | 1 | X | X | X | X | X | X | X | X | X | X | X | X |

Jd = M’ . Qc . Qb . Qa + M . Qc' . Qb’ . Qa’

Kd = M’ . Qb + M . Qb’ . Qa’

Jc = M’ . Qb . Qa + M . Qd . Qb’ . Qa’

Kc = M’ . Qb . Qa + M . Qb’ . Qa’

Jb = M’ . Qa + M . Qa’

Kb = Qd + M’ . Qa + M . Qa’

Ja = Qc + M’ . Qd’ + Qd . Qb’ + M . Qb

Ka = 1