Homework 7 question 4 (12.17)

Truth Table for D Flip Flop

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | D | A+ | B+ | C+ | D+ | DA | DB | DC | DD |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | X | X | X | X | X | X | X | X |
| 1 | 0 | 1 | 1 | X | X | X | X | X | X | X | X |
| 1 | 1 | 0 | 0 | X | X | X | X | X | X | X | X |
| 1 | 1 | 0 | 1 | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 0 | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 1 | X | X | X | X | X | X | X | X |

DA = BCD + AD’

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | 1 |
| 01 | 0 | 0 | X | 0 |
| 11 | 0 | 1 | X | X |
| 10 | 0 | 0 | X | X |

DB = B’CD + BC’ + BD’

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 1 | X | 0 |
| 01 | 0 | 1 | X | 0 |
| 11 | 1 | 0 | X | X |
| 10 | 0 | 1 | X | X |

DC =A’C’D’ + CD’

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | 0 |
| 01 | 1 | 1 | X | 0 |
| 11 | 0 | 0 | X | X |
| 10 | 1 | 1 | X | X |

DD = D’

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 1 | 1 | X | 1 |
| 01 | 0 | 0 | X | 0 |
| 11 | 0 | 0 | X | X |
| 10 | 1 | 1 | X | X |

Truth Table for JK Flip Flop

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | D | A+ | B+ | C+ | D+ | JA | KA | JB | KB | JC | KC | JD | KD |
| 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 | 0 | 0 | 0 | 0 | X | 1 | 0 | X | 0 | X | X | 1 |
| 1 | 0 | 1 | 0 | X | X | X | X | X | X | X | X | X | X | X | 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 |

JA = BCD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | X |
| 01 | 0 | 0 | X | X |
| 11 | 0 | 1 | X | X |
| 10 | 0 | 0 | X | X |

KA = D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | X | X | X | 0 |
| 01 | X | X | X | 1 |
| 11 | X | X | X | X |
| 10 | 0 | X | X | X |

JB = CD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | X | X | 0 |
| 01 | 0 | X | X | 0 |
| 11 | 1 | X | X | X |
| 10 | 0 | X | X | X |

KB = CD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | X | 0 | X | X |
| 01 | X | 0 | X | X |
| 11 | X | 1 | X | X |
| 10 | X | 0 | X | X |

JC = A’D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | 0 |
| 01 | 1 | 1 | X | 0 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

KC = D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | X | X | X | 0 |
| 01 | X | X | X | X |
| 11 | 1 | 1 | X | X |
| 10 | 0 | 0 | X | X |

JD = 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 1 | 1 | X | 1 |
| 01 | X | X | X | X |
| 11 | X | X | X | X |
| 10 | 1 | 1 | X | X |

KD = 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | X | X | X | 1 |
| 01 | 1 | 1 | X | 1 |
| 11 | 1 | 1 | X | X |
| 10 | X | X | X | X |

Truth Table for SR Flip Flop

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | D | A+ | B+ | C+ | D+ | SA | RA | SB | RB | SC | RC | SD | RD |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | X | 0 | X | 0 | X | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | X | 0 | X | 1 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | X | 0 | X | X | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | X | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | X | X | 0 | 0 | X | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | X | X | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | X | X | 0 | X | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | X | 0 | 0 | X | 0 | X | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | X | 0 | X | 0 | 1 |
| 1 | 0 | 1 | 0 | X | X | X | X | X | X | X | X | X | X | X | 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 |

SA = BCD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | X |
| 01 | 0 | 0 | X | 0 |
| 11 | 0 | 1 | X | X |
| 10 | 0 | 0 | X | X |

RA = AD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | X | X | X | 0 |
| 01 | X | X | X | 1 |
| 11 | X | 0 | X | X |
| 10 | X | X | X | X |

SB = B’CD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | X | X | 0 |
| 01 | 0 | X | X | 0 |
| 11 | 1 | 0 | X | X |
| 10 | 0 | X | X | X |

RB = BCD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | X | 0 | X | 0 |
| 01 | X | 0 | X | 0 |
| 11 | 0 | 1 | X | X |
| 10 | X | 0 | X | X |

SC = A’C’D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | X | 0 | X | 0 |
| 01 | X | 1 | X | 0 |
| 11 | 0 | 0 | X | X |
| 10 | X | X | X | X |

RC = CD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | X | X | X | 0 |
| 01 | 0 | 0 | X | 0 |
| 11 | 1 | 1 | X | X |
| 10 | 0 | 0 | X | X |

SD = D’

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 1 | 1 | X | 1 |
| 01 | 0 | 0 | X | 0 |
| 11 | 0 | 0 | X | X |
| 10 | 1 | 1 | X | X |

RD = D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | 0 |
| 01 | 1 | 1 | X | 1 |
| 11 | 1 | 1 | X | X |
| 10 | 0 | 0 | X | X |

Truth Table for T Flip Flop

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | D | A+ | B+ | C+ | D+ | TA | TB | TC | TD |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | X | X | X | X | X | X | X | X |
| 1 | 0 | 1 | 1 | X | X | X | X | X | X | X | X |
| 1 | 1 | 0 | 0 | X | X | X | X | X | X | X | X |
| 1 | 1 | 0 | 1 | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 0 | X | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 1 | X | X | X | X | X | X | X | X |

TA = BCD + AD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | 1 |
| 01 | 0 | 0 | X | 1 |
| 11 | 0 | 1 | X | X |
| 10 | 0 | 0 | X | X |

TB = CD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | 0 |
| 01 | 0 | 0 | X | 0 |
| 11 | 1 | 1 | X | X |
| 10 | 0 | 0 | X | X |

TC = A’D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | X | 0 |
| 01 | 1 | 1 | X | 0 |
| 11 | 1 | 1 | X | X |
| 10 | 0 | 0 | X | X |

TD = 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CD\AB | 00 | 01 | 11 | 10 |
| 00 | 1 | 1 | X | 1 |
| 01 | 1 | 1 | X | 1 |
| 11 | 1 | 1 | X | X |
| 10 | 1 | 1 | X | X |