## **CPE 522 ASSIGNMENT**

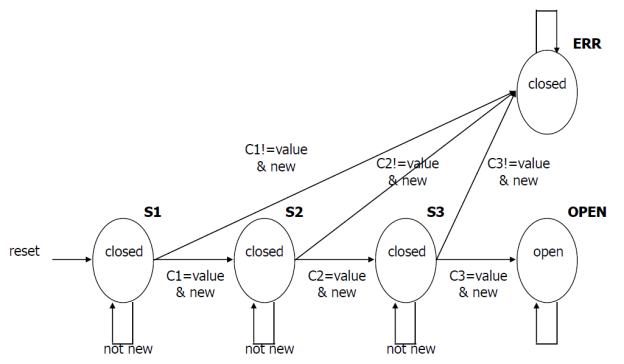
**Submitted to Engr. Olaye**

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## MATRICULATION NUMBER: ENG1503549

LEVEL: 500  
SEMESTER: 2ND SEMESTER

**QUESTION: Extract a state transition table from the state diagram below. Using a software tool to compute Quine Mccluskey’s minimization, obtain the minimal combinational Sum of Products for all outputs.**



Door Combination Lock State Diagram

### STATE TRANSITION TABLE

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Reset | New | Equal | Current State | Next  State | Next  Mux | Open / Closed |
| 1 | \_\_ | \_\_ | \_\_ | S1 | C1 | closed |
| 0 | 0 | \_\_ | S1 | S1 | C1 | closed |
| 0 | 1 | 0 | S1 | ERR | \_\_ | closed |
| 0 | 1 | 1 | S1 | S2 | C2 | closed |
| 0 | 0 | \_\_ | S2 | S2 | C2 | closed |
| 0 | 1 | 0 | S2 | ERR | \_\_ | closed |
| 0 | 1 | 1 | S2 | S3 | C3 | closed |
| 0 | 0 | \_\_ | S3 | S3 | C3 | closed |
| 0 | 1 | 0 | S3 | ERR | \_\_ | closed |
| 0 | 1 | 1 | S3 | OPEN | \_\_ | closed |
| 0 | \_\_ | \_\_ | OPEN | OPEN | \_\_ | open |
| 0 | \_\_ | \_\_ | ERR | ERR | \_\_ | closed |

### ENCODING OF THE SYMBOLIC STATES

|  |  |
| --- | --- |
| SYMBOLS | ENCODING |
| S1 | 000 |
| S2 | 001 |
| S3 | 010 |
| OPEN | 011 |
| ERR | 100 |
|  |  |
| C1 | 00 |
| C2 | 01 |
| C3 | 10 |

### STATE TRANSITION TABLE WITH ENCODED STATES

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Reset | New | Equal | Current State  s0, s1, s2 | Next  State  n0, n1, n2 | Next  Mux  c0, c1 | Open / Closed |
| 1 | \_\_ | \_\_ | \_\_ | 000 | 00 | 0 |
| 0 | 0 | \_\_ | 000 | 000 | 00 | 0 |
| 0 | 1 | 0 | 000 | 100 | \_\_ | 0 |
| 0 | 1 | 1 | 000 | 001 | 01 | 0 |
| 0 | 0 | \_\_ | 001 | 001 | 01 | 0 |
| 0 | 1 | 0 | 001 | 100 | \_\_ | 0 |
| 0 | 1 | 1 | 001 | 010 | 10 | 0 |
| 0 | 0 | \_\_ | 010 | 010 | 10 | 0 |
| 0 | 1 | 0 | 010 | 100 | \_\_ | 0 |
| 0 | 1 | 1 | 010 | 011 | \_\_ | 0 |
| 0 | \_\_ | \_\_ | 011 | 011 | \_\_ | 1 |
| 0 | \_\_ | \_\_ | 100 | 100 | \_\_ | 0 |

## 2.0 OUTPUTS

The outputs are Next State (N0, N1, N2), Next Mux (C0, C1), and Open. The inputs are Reset, New, Equal and Current State (S0, S1, S2).

The software used to generate the QM minimisations can be found at https://atozmath.com/KMap.aspx?q=quine

N0 (Next State)

Minterm = 16,17,18,4,12,20,28

Don't Care = 5,6,7,13,14,15,21,22,23,29,30,31

Variable = r, n, e, s0, s1, s2

Prime implicant chart

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PIs\Minterms | 4 | 12 | 16 | 17 | 18 | 20 | 28 | r, n, e, s0, s1, s2 |
| 16,17,20,21 |  |  | X | X |  | X |  | 010-0- |
| 16,18,20,22 |  |  | X |  | X | X |  | 010--0 |
| 4,5,6,7,12,13,14,15,20,21,22,23,28,29,30,31 | X | X |  |  |  | X | X | 0--1-- |

Extracted essential prime implicants: 0--1--,010-0-,010--0

All extracted essential prime implicants: 0--1--,010-0-,010--0

Minimal Quine McCluskey Expression = **r’s0 + r’ne’s1’ + r’ne’s2’**

N1(Next State)

Minterm = 25,2,10,26,3,11,19,27

Don't Care = 5,6,7,13,14,15,21,22,23,29,30,31

Variable = r, n, e, s0, s1, s2

Prime implicant chart

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PIs\Minterms | 2 | 3 | 10 | 11 | 19 | 25 | 26 | 27 | r, n, e, s0, s1, s2 |
| 25,27,29,31 |  |  |  |  |  | X |  | X | 011--1 |
| 2,3,6,7,10,11,14,15 | X | X | X | X |  |  |  |  | 00--1- |
| 3,7,11,15,19,23,27,31 |  | X |  | X | X |  |  | X | 0---11 |
| 10,11,14,15,26,27,30,31 |  |  | X | X |  |  | X | X | 0-1-1- |
| 5,7,13,15,21,23,29,31 |  |  |  |  |  |  |  |  | 0--1-1 |
| 6,7,14,15,22,23,30,31 |  |  |  |  |  |  |  |  | 0--11- |

Extracted essential prime implicants: 00--1-,0---11,011--1,0-1-1-

All extracted essential prime implicants: 00--1-,0---11,011--1,0-1-1-

Minimal Quine McCluskey Expression = **r’n’s1 + r’s1s2 + r’nes2 + r’es1**

N2 (Next State)

Minterm = 24,1,9,26,3,11,19,27

Don't Care = 5,6,7,13,14,15,21,22,23,29,30,31

Variable = r, n, e, s0, s1, s2

Prime implicant chart

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PIs\Minterms | 1 | 3 | 9 | 11 | 19 | 24 | 26 | 27 | r, n, e, s0, s1, s2 |
| 24,26 |  |  |  |  |  | X | X |  | 0110-0 |
| 26,27,30,31 |  |  |  |  |  |  | X | X | 011-1- |
| 1,3,5,7,9,11,13,15 | X | X | X | X |  |  |  |  | 00---1 |
| 3,7,11,15,19,23,27,31 |  | X |  | X | X |  |  | X | 0---11 |
| 5,7,13,15,21,23,29,31 |  |  |  |  |  |  |  |  | 0--1-1 |
| 6,7,14,15,22,23,30,31 |  |  |  |  |  |  |  |  | 0--11- |

Extracted essential prime implicants: 00---1,0---11,0110-0

All extracted essential prime implicants: 00---1,0---11,0110-0

Minimal Quine McCluskey Expression = **r’n’s2 + r’s1s2 + r’nes0’s2’**

C0 (Next Mux)

Minterm = 25,2,10

Don’t Care = 16,17,18,26,4,12,20,28,3,11,19,27,5,6,7,13,14,15,21,22,23,29,30,31

Variable = r, n, e, s0, s1, s2

Prime implicant chart

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PIs\Minterms | 2 | 10 | 25 | r, n, e, s0, s1, s2 |
| 16,17,18,19,20,21,22,23 |  |  |  | 010--- |
| 17,19,21,23,25,27,29,31 |  |  | X | 01---1 |
| 2,3,6,7,10,11,14,15,18,19,22,23,26,27,30,31 | X | X |  | 0---1- |
| 4,5,6,7,12,13,14,15,20,21,22,23,28,29,30,31 |  |  |  | 0--1-- |

Extracted essential prime implicants: 0---1-,01---1

All extracted essential prime implicants: 0---1-,01---1

Minimal Quine McCluskey Expression = **r’s1 + r’ns2**

### 

### C1 (Next Mux)

Minterm = 24,1,9

Don’t Care = 16,17,18,26,4,12,20,28,3,11,19,27,5,6,7,13,14,15,21,22,23,29,30,31

Variable = r, n, e, s0, s1, s2

Prime implicant chart

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PIs\Minterms | 1 | 9 | 24 | r, n, e, s0, s1, s2 |
| 1,3,5,7,9,11,13,15 | X | X |  | 00---1 |
| 1,3,5,7,17,19,21,23 | X |  |  | 0-0--1 |
| 16,18,20,22,24,26,28,30 |  |  | X | 01---0 |
| 16,17,18,19,20,21,22,23 |  |  |  | 010--- |
| 3,7,11,15,19,23,27,31 |  |  |  | 0---11 |
| 18,19,22,23,26,27,30,31 |  |  |  | 01--1- |
| 4,5,6,7,12,13,14,15,20,21,22,23,28,29,30,31 |  |  |  | 0--1-- |

Extracted essential prime implicants: 00---1,01---0

All extracted essential prime implicants: 00---1,01---0

Minimal Quine McCluskey Expression = **r’n’s2 + r’ns2’**

### Open (Output)

Minterm = 3,11,19,27

Don’t Care = 5,6,7,13,14,15,21,22,23,29,30,31

Variable = r, n, e, s0, s1, s2

Prime implicant chart

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PIs\Minterms | 3 | 11 | 19 | 27 | r, n, e, s0, s1, s2 |
| 3,7,11,15,19,23,27,31 | X | X | X | X | 0---11 |
| 5,7,13,15,21,23,29,31 |  |  |  |  | 0--1-1 |
| 6,7,14,15,22,23,30,31 |  |  |  |  | 0--11- |

Extracted essential prime implicants: 0---11

All extracted essential prime implicants: 0---11

Minimal Quine McCluskey Expression = **r’s1s2**