CS 20 Laboratory 8: Sequential Circuit Design

1. (2pt) Mealy state diagram

Diagram

Description automatically generated

1. (2pt) State table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Present Input (*x1x2*) | | | | |
|  | 00 | 01 | 11 | 10 |
| Present State  (S\_q1q2q3) | S\_000 | S\_000, 000 | S\_001, 001 | X | S\_100, 100 |
| S\_001 | S\_001, 001 | S\_011, 011 | X | S\_000, 000 |
| S\_011 | S\_011, 011 | S\_010, 010 | X | S\_001, 001 |
| S\_010 | S\_010, 010 | S\_110, 110 | X | S\_011, 011 |
| S\_110 | S\_110, 110 | S\_111, 111 | X | S\_010, 010 |
| S\_111 | S\_111, 111 | S\_101, 101 | X | S\_110, 110 |
| S\_101 | S\_101, 101 | S\_100, 100 | X | S\_111, 111 |
| S\_100 | S\_100, 100 | S\_000, 000 | X | S\_101, 101 |

1. (4pts) Table with present state, current input, next state, and output.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Current input | | Present State | | | Next State | | | Output | | | |
| x1 | x2 | q1 | q2 | q3 | q1+ | q2+ | q3+ | y1 | y2 | y3 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | X | X | X | X | X | X |
| 1 | 1 | 0 | 0 | 1 | X | X | X | X | X | X |
| 1 | 1 | 0 | 1 | 0 | X | X | X | X | X | X |
| 1 | 1 | 0 | 1 | 1 | X | X | X | X | X | X |
| 1 | 1 | 1 | 0 | 0 | X | X | X | X | X | X |
| 1 | 1 | 1 | 0 | 1 | X | X | X | X | X | X |
| 1 | 1 | 1 | 1 | 0 | X | X | X | X | X | X |
| 1 | 1 | 1 | 1 | 1 | X | X | X | X | X | X |

1. (3pts) Minimized sum-of-product K-maps of the following:
   1. (1pt) Output bit y1.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| x1 x2 | q1 q2 q3 | | | | | | | | |
|  | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
| 00 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 01 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 11 | X | X | X | X | X | X | X | X |
| 10 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |

SOP expression of y1: **x1’x2’q1 + x2q2q3’ + q1q3 + x1q2’q3’**

* 1. (1pt) Output bit y2.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| x1 x2 | q1 q2 q3 | | | | | | | | |
|  | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
| 00 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 01 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 11 | X | X | X | X | X | X | X | X |
| 10 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |

SOP expression of y2: **x1’x2’q2 + x2q1’q3 + q2q3’ + x1q1q3**

* 1. (1pt) Output bit y3.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| x1 x2 | q1 q2 q3 | | | | | | | | |
|  | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
| 00 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 01 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 11 | X | X | X | X | X | X | X | X |
| 10 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |

SOP expression of y3: **x1’x2’q3 + x2q1’q2’ + x1q1’q2 + x2q1q2 + x1q1q2’**