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15/ENG02/041

Computer Engineering

Q Give the following functions

$$A(x_1, x_2, x_3, x_4) = \sum m(3, 7, 8, 9, 11, 15)$$

$$B(x_1, x_2, x_3, x_4) = \sum m(3, 4, 5, 7, 10, 14, 15)$$

$$C(x_1, x_2, x_3, x_4) = \sum m(1, 5, 7, 11, 15)$$

Design the system using PLA

truth table of ^{the} PLA

| | x_1 | x_2 | x_3 | x_4 | A | B | C |
|---|-------|-------|-------|-------|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 4 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 5 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 6 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 7 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |

| | | | | | | | |
|----|---|---|---|---|---|---|---|
| 9 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 10 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 11 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 12 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 13 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| 14 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 15 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

K-map for function A

| | | | | | |
|-----------|-----------|----------------|----------------|-----------------|-----------------|
| | $x_3 x_4$ | 00 | 01 | 11 | 10 |
| $x_1 x_2$ | 00 | 0 ₀ | 0 ₄ | 0 ₁₂ | 1 ₈ |
| | 01 | 0 ₁ | 0 ₅ | 0 ₁₃ | 1 ₉ |
| | 11 | 1 ₃ | 1 ₇ | 1 ₁₅ | 1 ₁₁ |
| | 10 | 0 ₂ | 0 ₆ | 0 ₁₄ | 0 ₁₀ |

$$A = x_3 x_4 + x_1 \bar{x}_2 \bar{x}_3$$

K-map for function B

| | | | | | |
|------------|---|------------|----|----|----|
| | | x_1, x_2 | | | |
| x_3, x_4 | | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | 1 | 0 | 0 |
| 01 | 0 | 0 | 1 | 0 | 0 |
| 11 | 1 | 1 | 1 | 1 | 0 |
| 10 | 0 | 0 | 0 | 1 | 1 |

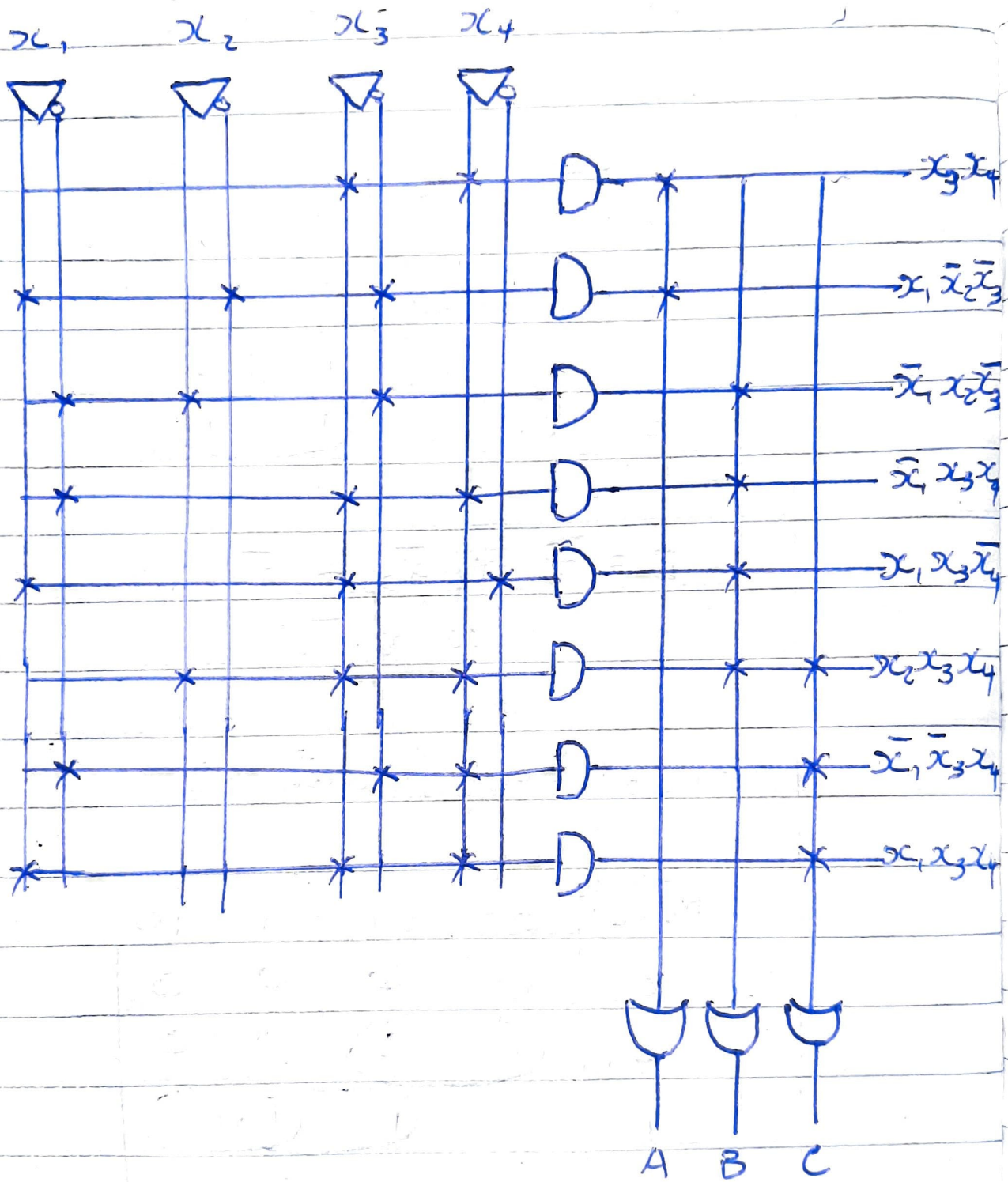
$$B = \bar{x}_1 \bar{x}_2 \bar{x}_3 + \bar{x}_1 x_3 x_4 + x_2 x_3 x_4 + x_1 x_3 \bar{x}_4$$

K-map for function C

| | | | | | |
|------------|---|------------|----|----|----|
| | | x_1, x_2 | | | |
| x_3, x_4 | | 00 | 01 | 11 | 10 |
| 00 | 0 | 0 | 0 | 0 | 0 |
| 01 | 1 | 1 | 0 | 0 | |
| 11 | 0 | 1 | 1 | 1 | |
| 10 | 0 | 0 | 0 | 0 | |

$$C = \bar{x}_1 \bar{x}_3 x_4 + x_2 x_3 x_4 + x_1 x_3 x_4$$

PLA DESIGN



② truth table

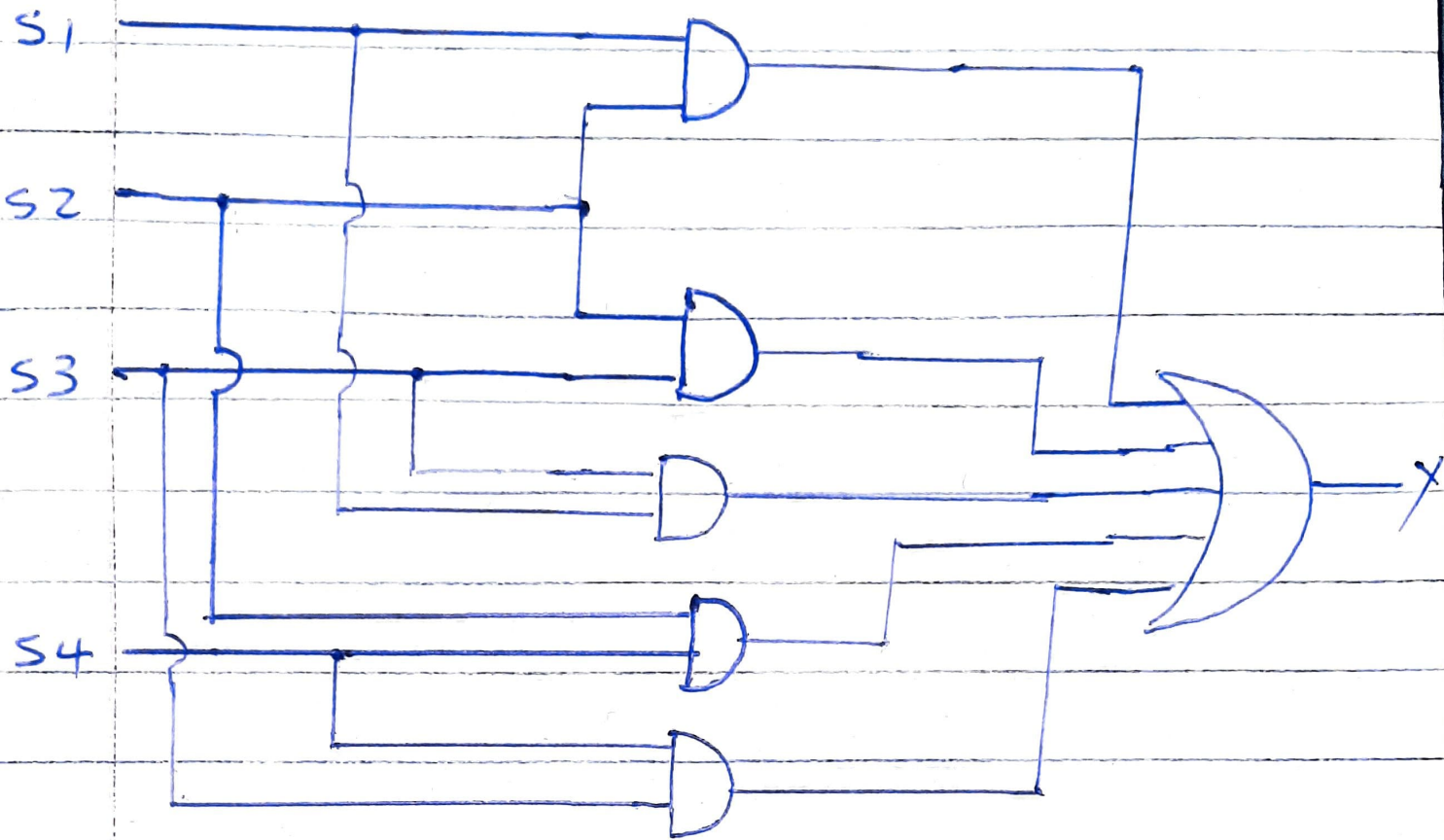
| | SW1 | SW2 | SW3 | SW4 | output Y |
|----|-----|-----|-----|-----|-------------|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 |
| 2 | 0 | 0 | 1 | 0 | 0 |
| 3 | 0 | 0 | 1 | 1 | 1 |
| 4 | 0 | 1 | 0 | 0 | 0 |
| 5 | 0 | 1 | 0 | 1 | 1 |
| 6 | 0 | 1 | 1 | 0 | 1 |
| 7 | 0 | 1 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 | 0 |
| 9 | 1 | 0 | 0 | 1 | X |
| 10 | 1 | 0 | 1 | 0 | - |
| 11 | 1 | 0 | 1 | 1 | X |
| 12 | 1 | 1 | 0 | 0 | - |
| 13 | 1 | 1 | 0 | 1 | X |
| 14 | 1 | 1 | 1 | 0 | - |
| 15 | 1 | 1 | 1 | 1 | X |

using k-map to simplify the expression

| | | | | | | | |
|-----|----|-----|-----|----|----|----|----|
| | | SW1 | | | | | |
| | | SW3 | SW2 | 00 | 01 | 11 | 10 |
| SW4 | 00 | 0 | 0 | 1 | 0 | x | |
| | 01 | 0 | 1 | X | X | ? | |
| | 11 | 1 | 1 | X | X | 11 | |
| | 10 | 0 | 1 | 1 | 1 | 10 | |
| | | | | | | | |

$$Y = SW3SW4 + SW1SW2 + SW2SW4 + SW1SW3$$

$$Y = S3S4 + S1S2 + S2S4 + S1S3 + S2S3$$




```
LIBRARY ieee ;
USE ieee.std_logic_1164.ALL;
ENTITY switch IS
PORT (S1, S2, S3, S4 : IN std_logic;
      Y : out std_logic);
END switch ;
ARCHITECTURE dataflow of switch IS
BEGIN
  Y <= (S3 and S4) or (S1 and S2)
      or (S2 and S4) or (S1 and S3)
      or (S2 and S3);
END dataflow;
```