# EE5803 - FPGA LAB
# Assignment-1

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**Q**. Reduce the following boolean expression to its simplest form using K-Map.

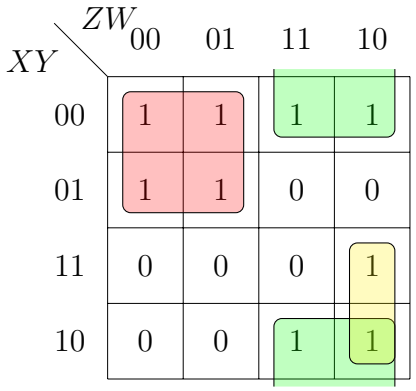
$$F(X, Y, Z, W) = \sum(0, 1, 2, 3, 4, 5, 10, 11, 14) \tag{1}$$

**Sol**. First we will build a Truth Table for the given expression as below,

| X | Y | Z | W | **F** |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | **1** |
| 0 | 0 | 0 | 1 | **1** |
| 0 | 0 | 1 | 0 | **1** |
| 0 | 0 | 1 | 1 | **1** |
| 0 | 1 | 0 | 0 | **1** |
| 0 | 1 | 0 | 1 | **1** |
| 0 | 1 | 1 | 0 | **0** |
| 0 | 1 | 1 | 1 | **0** |
| 1 | 0 | 0 | 0 | **0** |
| 1 | 0 | 0 | 1 | **0** |
| 1 | 0 | 1 | 0 | **1** |
| 1 | 0 | 1 | 1 | **1** |
| 1 | 1 | 0 | 0 | **0** |
| 1 | 1 | 0 | 1 | **0** |
| 1 | 1 | 1 | 0 | **1** |
| 1 | 1 | 1 | 1 | **0** |

Table 1: The Truth Table

K-Map for the given expression as below




The implicants in 0,1,4,5 gives us $\bar{X}\bar{Z}$
The implicatns in 2,3,10,11 gives us $\bar{Y}Z$
The implicants in 10,14 gives us $XZ\bar{W}$

Combining all the above terms will give us

$$F(X,Y,Z,W) = \bar{X}\bar{Z} + \bar{Y}Z + XZ\bar{W} \tag{2}$$

In order to implement it using NAND gates, we will write the above SOP form as below

$$F(X,Y,Z,W) = \overline{(\bar{X}\bar{Z} + \bar{Y}Z + XZ\bar{W})} \tag{3}$$

$$F(X,Y,Z,W) = \overline{(\bar{X}\bar{Z}.\bar{Y}Z.\overline{XZ\bar{W}})} \tag{4}$$