**Introduction to Computer Organisation and Architecture**

**Tutorial-6**

1. Write a simplified expression for the Boolean function defined by each of the following Kmaps :

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| A\BC | 00 | 01 | | | 11 | | 10 |
| 0 | 1 | | 0 | 1 | | 1 | |
| 1 | 0 | | 0 | 1 | | 1 | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| A\BC | 00 | 01 | | | 11 | | 10 |
| 0 | 1 | | 0 | 1 | | 1 | |
| 1 | 1 | | 1 | 0 | | 1 | |

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

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

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

1. Construct the K-MAP of the following Boolean expressions. Then, simplify the expression
2. F = A’.B’.C + A.B’.C + A’.B.C’ + A.B.C’
3. F = A’.B’.C’.D’ + A’.B.C’.D’ +A’.B.D + A.B.C’.D + A.B.C.D
4. F = (A+B+C’).(A+B’+C’).(A+B’+C)
5. F = (A+B+C+D’).(A+B+C’+D’).(A+B’+C+D’).(A+B’+C’+D’)
6. For the Boolean function *F* specified by the following truth table:

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

1. Construct the SOP and POS forms of *F*.
2. Simplify in SOP using the Boolean algebra.
3. Use K-map to derive *F.*
4. Simplify the following Boolean Expression using Boolean Algebra
5. *F* = X.Z’.(Y+X) + X.Y’
6. *F* =X’.Y + X.(X+Y’)
7. *F =*(((X.Y)’.Z)’.((X.Y)’.Y)’)’
8. *F*= (D’.D’.E)’
9. For the Boolean function *F* specified by the following truth table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *A* | *B* | *C* | *D* | *F* |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 0 |

1. Construct the SOP forms of *F*.
2. Simplify *F* in SOP using Boolean algebra.



6 A combinational circuit is used to control a seven-segment display of decimal digits, as shown in the figure above. The circuit has four inputs, which provide the four-bit code used in packed decimal representation. The seven outputs define which segments will be activated to display a given decimal digit. Note that some combinations of inputs and outputs are not needed.

1. Develop a truth table for this circuit.
2. Express the truth table in SOP form.
3. Express the truth table in POS form.

**Extra Questions (From Hamacher Ed 6)**

1. Prove the following identities by using algebraic manipulation
2. Find a minimum cost implementation of the function *f*(*x1*, *x2*, *x3*, *x4*), where f = 1 if either one or two of the input variables have the logic value 1. Otherwise f = 0
3. Consider the following function:
4. Use a Karnaugh map to find a minimum cost sum-of-products (SOP) and (POS) product-of-sum expression for f.
5. Find the minimum cost SOP expression for , which is the complement of *f.* Then, complement (using de Morgan’s rule) this SOP expression to find an expression for *f*. Compare the result of (a) and (b) and make a conclusion.