***Karnaugh Map***

1.    Design a 4-bit combinational circuit incremented (the circuit that adds one to a 4-bit binary number). The circuit can be designed using four half adders.

Cn = BC +AB +AC

Sn = Cn-1 ⊕ An⊕Bn)

Co = AoBo

So = A⊕B

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| S0 |  |  |  |  |  |  |  |  |
|  | B |  |  |  |  |  |  |  |
| A | 0 | 1 |  |  |  |  |  |  |
| 0 | 0 | 1 |  |  |  |  |  |  |
| 1 | 1 | 0 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| C0 |  |  |  |  |  |  |  |  |
|  | B |  |  |  |  |  |  |  |
| A | 0 | 1 |  |  |  |  |  |  |
| 0 | 0 | 0 |  |  |  |  |  |  |
| 1 | 0 | 1 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Sn |  |  |  |  |  |  |  |  |
|  | BC |  |  |  |  |  |  |  |
| A | 00 | 01 | 11 | 10 |  |  |  |  |
| 0 | 0 | 1 | 0 | 1 |  |  |  |  |
| 1 | 1 | 0 | 1 | 0 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Cn |  |  |  |  |  |  |  |  |
|  | BC |  |  |  |  |  |  |  |
| A | 00 | 01 | 11 | 10 |  |  |  |  |
| 0 | 0 | 0 | 1 | 0 |  |  |  |  |
| 1 | 0 | 1 | 1 | 1 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| A0 | B0 | S0 | C0 |  |  |  |  |  |
| 0 | 0 | 0 | 0 |  |  |  |  |  |
| 0 | 1 | 1 | 0 |  |  |  |  |  |
| 1 | 0 | 1 | 0 |  |  |  |  |  |
| 1 | 1 | 0 | 1 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| An | Bn | Cn-1 | Sn | Cn |  |  |  |  |
| 0 | 0 | 0 | 0 | 0 |  |  |  |  |
| 0 | 0 | 1 | 1 | 0 |  |  |  |  |
| 0 | 1 | 0 | 1 | 0 |  |  |  |  |
| 0 | 1 | 1 | 0 | 1 |  |  |  |  |
| 1 | 0 | 0 | 1 | 0 |  |  |  |  |
| 1 | 0 | 1 | 0 | 1 |  |  |  |  |
| 1 | 1 | 0 | 0 | 1 |  |  |  |  |
| 1 | 1 | 1 | 1 | 1 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |