①

ⓐ $F1(A,B,C,D) = \bar{A}B + A\bar{B} + \bar{C}D$

| $\bar{A}B\_\_$ | $A\bar{B}\_\_$ | $\_\_\bar{C}D$ |
|---|---|---|
| 0100 | 1000 | 0001 |
| 0101 | 1001 | 0101 |
| 0110 | 1010 | 1001 |
| 0111 | 1011 | 1101 |

$f1(A,B,C) = \sum m(1,4,5,6,7,8,9,10,11,13)$

$= \bar{A}\bar{B}\bar{C}D + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + \bar{A}BCD +$
$A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + A\bar{B}CD + AB\bar{C}D$

ⓑ $F2(A,B,C,D) = (A+B)(\bar{C}+\bar{D})(C+D)$

$(A+B+\_+\_)(\_+\_+\bar{C}+\bar{D})(\_+\_+C+D)$

| | | |
|---|---|---|
| 0000 | 0011 | 0000 |
| 0001 | 0111 | 0100 |
| 0010 | 1011 | 1000 |
| 0011 | 1111 | 1100 |

$f2(A,B,C,D) = \prod M(0,1,2,3,4,7,8,11,12,15)$

$= (A+B+C+D)(A+B+C+\bar{D})(A+B+\bar{C}+D)(A+B+\bar{C}+\bar{D})$
$(A+\bar{B}+C+D)(A+\bar{B}+\bar{C}+\bar{D})(\bar{A}+B+C+D)(\bar{A}+B+\bar{C}+\bar{D})$
$(\bar{A}+\bar{B}+C+D)(\bar{A}+\bar{B}+\bar{C}+\bar{D})$

ⓒ $F2(A,B,C,D) = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} +$
$\bar{A}BCD + A\bar{B}\bar{C}\bar{D} + A\bar{B}CD + AB\bar{C}\bar{D} + ABCD$

(2)

(a) $F(A,B,C) = AC + A\bar{B} + \bar{A}BC + \bar{A}\bar{B}\bar{C}$

$= C(A + \bar{A}B) + \bar{B}(A + \bar{A}\bar{C})$

using $x + \bar{x}y = x + y$

$= C(A+B) + \bar{B}(A + \bar{C})$

$= AB + AC + A\bar{B} + \bar{B}\bar{C}$

(b) $B \oplus (AB + BC + \bar{A}C)$

$AB + \bar{A}C + BC(A+\bar{A})$

$= AB + \bar{A}C + ABC + \bar{A}BC$

$= AB(1+C) + \bar{A}C(1+B)$

$= AB + \bar{A}C$

— consensus theorem.

$= B \oplus (AB + \bar{A}C)$

$= \bar{B}(AB + \bar{A}C) + B(\bar{A}+\bar{B})(A+\bar{C})$

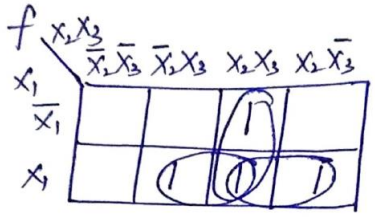
$= \bar{A}\bar{B}C + \bar{A}B\bar{C}$

$= \bar{A}(\bar{B}C + B\bar{C})$

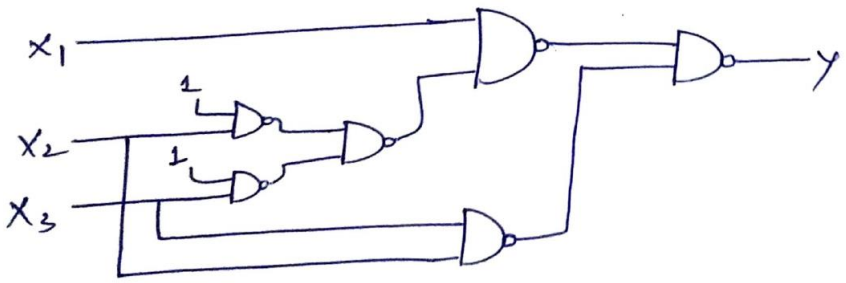
$= \bar{A}(B \oplus C)$

(5)

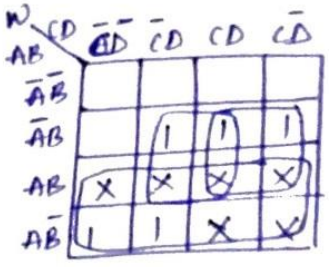
| $x_1$ | $x_2$ | $x_3$ | $f$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |



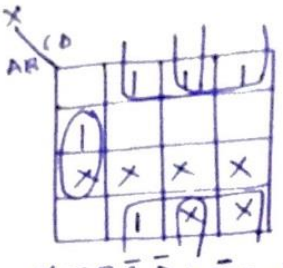

$$f = x_2x_3 + x_1x_3 + x_1x_2$$



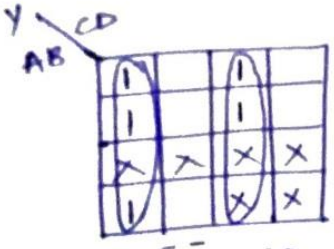
| 4-bit BCD | | | | EXCESS-3 | | | |
|---|---|---|---|---|---|---|---|
| A | B | C | D | W | X | Y | Z |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |




$W = A + BD + BC$

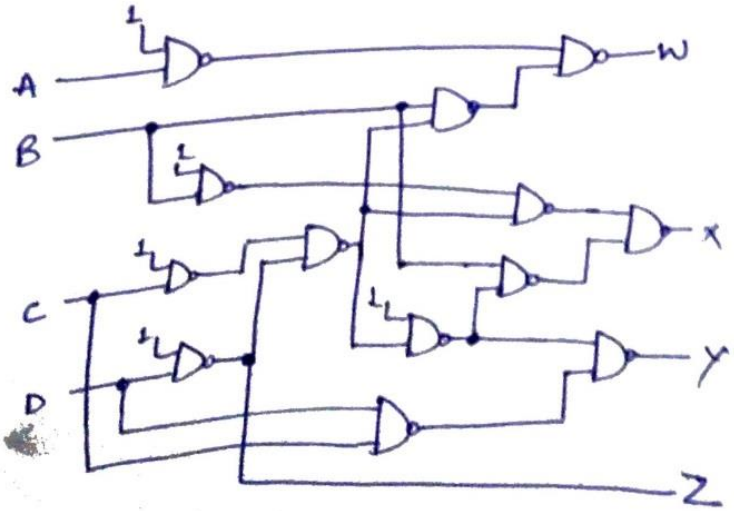



$X = B\bar{C}\bar{D} + \bar{B}D + \bar{B}C$




$Y = \bar{C}\bar{D} + CD$

$Z = \bar{D}$

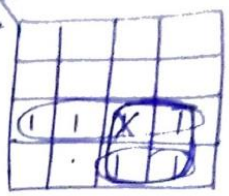


(7)

for 09 = a b c d e f g h
0 0 0 0 1 0 0 1

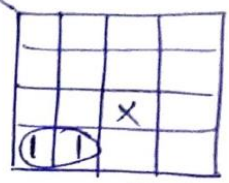
| $C_3$ $S_2$ $S_1$ $S_0$ | a b c d e f g h |
|---|---|
| 0 0 0 0 | 0 0 0 0 0 0 0 1 |
| 0 0 0 1 | 0 0 0 0 0 0 1 0 |
| 0 0 1 0 | 0 0 0 0 0 0 1 1 |
| 0 0 1 1 | 0 0 0 0 0 1 0 0 |
| 0 1 0 0 | 0 0 0 0 0 1 0 1 |
| 0 1 0 1 | 0 0 0 0 0 1 1 0 |
| 0 1 1 0 | 0 0 0 0 0 1 1 1 |
| 0 1 1 1 | 0 0 0 0 1 0 0 0 |
| 1 0 0 0 | 0 0 0 0 1 0 0 1 |
| 1 0 0 1 | 0 0 0 1 0 0 0 0 |
| 1 0 1 0 | 0 0 0 1 0 0 0 1 |
| 1 0 1 1 | 0 0 0 1 0 0 1 0 |
| 1 1 0 0 | 0 0 0 1 0 0 1 1 |
| 1 1 0 1 | 0 0 0 1 0 1 0 0 |
| 1 1 1 0 | 0 0 0 X X X X X ← sum can't be 15 |
| 1 1 1 1 | |

d



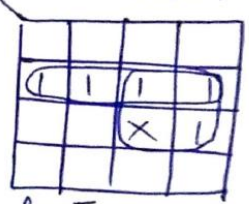
$d = C_3S_2 + C_3S_1$

e



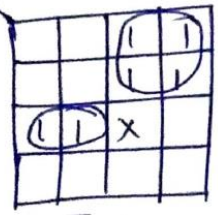
$e = C_3\bar{S}_2\bar{S}_1$

f



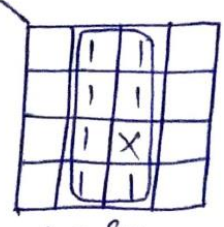
$f = \bar{C}_3S_2 + S_2S_1$

g



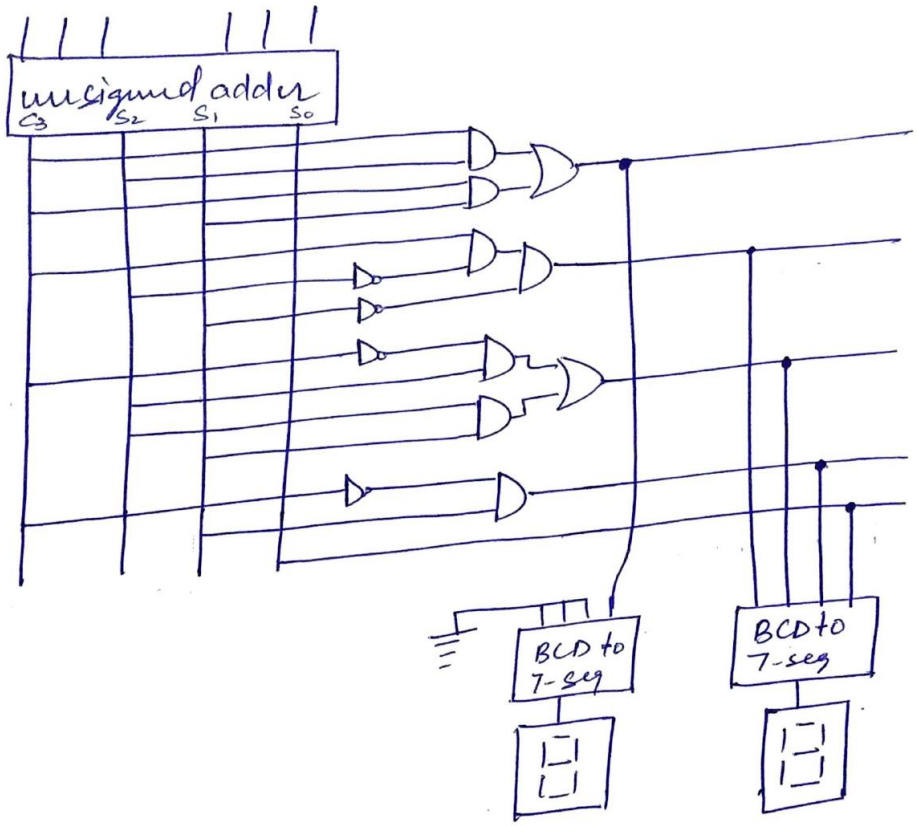
$g = \bar{C}_3S_1$

h

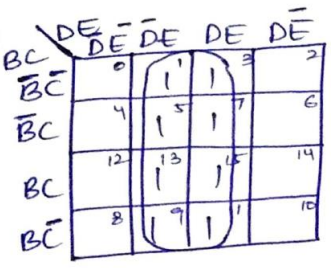


$h = S_0$

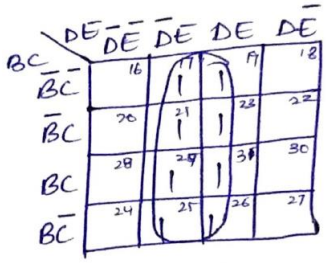
(7)




(8)



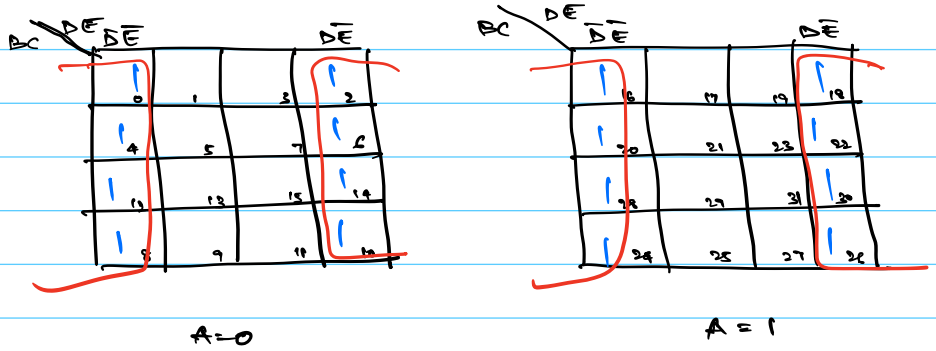

A=0




A=1

$f(A,B,C,D,E) = \bar{A}E + AE = E$

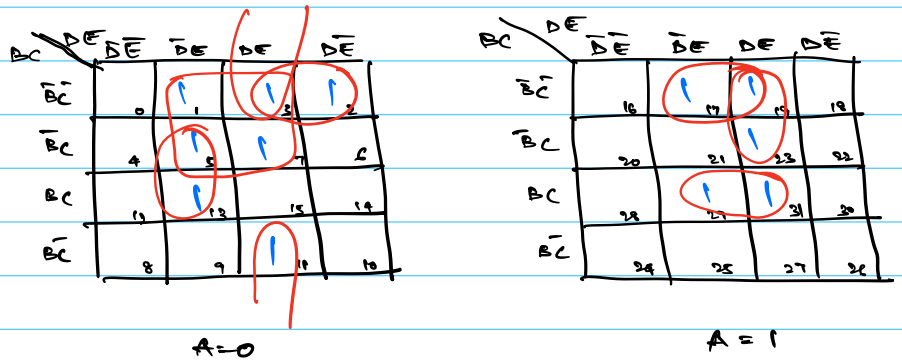
(9)




$F(A,B,C,D,E) = \bar{A}\cdot\bar{E} + A\cdot\bar{E} = \bar{E}$

(10)

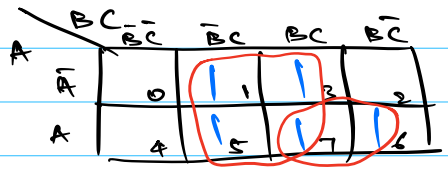
(a)




* Essential Prime Implicants: $\bar{A}\bar{B}E$, $\bar{A}C\bar{D}E$, $\bar{A}\bar{B}\bar{C}D$, $\bar{A}\bar{C}DE$, $A\bar{B}\bar{C}E$, $A\bar{B}\bar{D}E$, $ABCE$

* prime Implicant: $\bar{A}\bar{B}E$, $\bar{A}C\bar{D}E$, $\bar{A}\bar{B}\bar{C}D$, $\bar{A}\bar{C}DE$, $A\bar{B}\bar{C}E$, $A\bar{B}\bar{D}E$, $ABCE$, $ACDE$

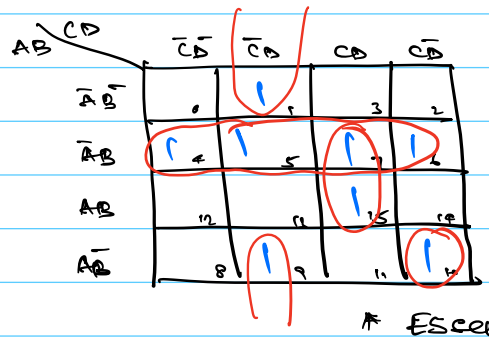
(b)




* Essential prime Implicants : C, AB

* Prime Implicants : C, AB

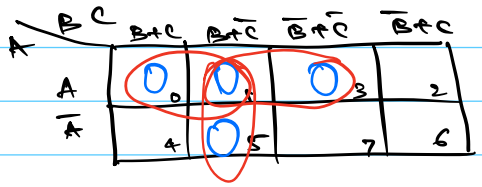
(c)




* Essential prime Implicants : $\bar{A}B$, $BCD$, $\bar{B}\bar{C}D$, $A\bar{B}\bar{C}\bar{D}$

* Prime Implicants : $\bar{A}B$, $BCD$, $\bar{B}\bar{C}D$, $A\bar{B}\bar{C}\bar{D}$, $\bar{A}\bar{C}D$

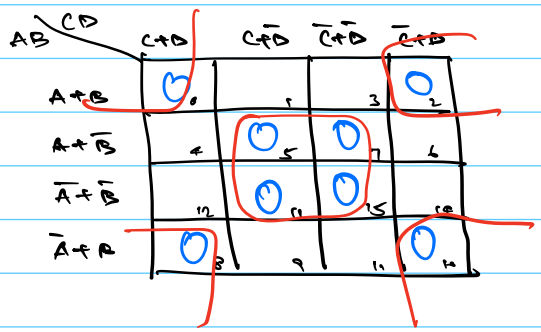
(d)




* Essential prime Implicants : $A+B$, $A+\bar{C}$, $B+\bar{C}$

* prime Implicants : $A+B$, $A+\bar{C}$, $B+\bar{C}$

(e)




* Essential Prime Implicants : $A+\bar{D}$, $B+D$

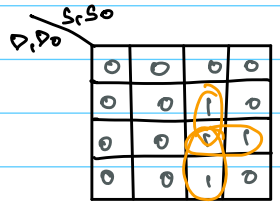
* prime Implicants : $A+\bar{D}$, $B+D$

(11)

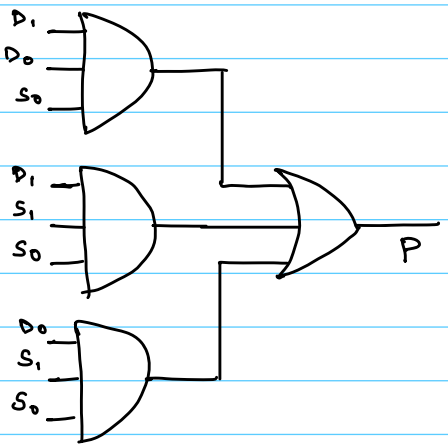
| $D_1$ | $D_0$ | | |
|---|---|---|---|
| 0 | 0 | ⇒ | Forward |
| 0 | 1 | | Reverse |
| 1 | 0 | | Right |
| 1 | 1 | | Left |

| $S_1$ | $S_0$ | | |
|---|---|---|---|
| 0 | 0 | ⇒ | Zero |
| 0 | 1 | | Low |
| 1 | 0 | | Medium |
| 1 | 1 | | High |

| $D_1$ | $D_0$ | $S_1$ | $S_0$ | P |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |




⇒ $P = D_1D_0S_0 + D_1S_1S_0 + D_0S_1S_0$




(12)

| PL \| PH | 0 | 1 | TL \| TH | 0 | 1 |
|---|---|---|---|---|---|
| 0 | Normal | Low | 0 | Normal | Low |
| 1 | High | High | 1 | High | Low |

* $H = TL \cdot TH \cdot \overline{PH}$
* $V = PL \cdot \overline{PH} \cdot \overline{TL}$
* $A = PH \cdot TH \cdot \overline{TL} + PL \cdot \overline{PH} \cdot TL$

(13)

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Date.

Que 13

let A = 1 if dividend on stock > dividend on bond
else A = 0.

let B = 1 if growth rate of stock > bond for 2% annually for last 5 years
else B = 0

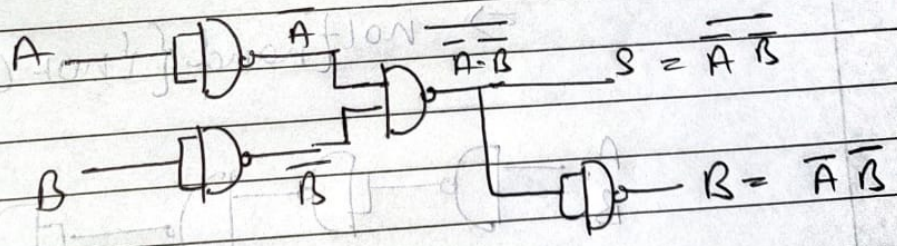
⇒ Now, for buying stock either A = 1 or if A = 0 Then B should be 1

Hence $S = A + \bar{A}B$

$\Rightarrow \overline{A+B} = \overline{\overline{A+B}} = \bar{A} \cdot \bar{B}$

⇒ Now, for buying bonds

$B = \bar{S} = \bar{A}\,\bar{B} \Rightarrow \overline{\bar{A}\,\bar{B}}$



13

Q13

Restating the problem,

we can say if driver reaches on time, then (A=1 else A=0)

and if Total passengers are >= 10, then (B=1 else B=0)

then Bus will reach on time and if it does not rain (C=1 else C=0) then the bus will travel at 60 kmph.

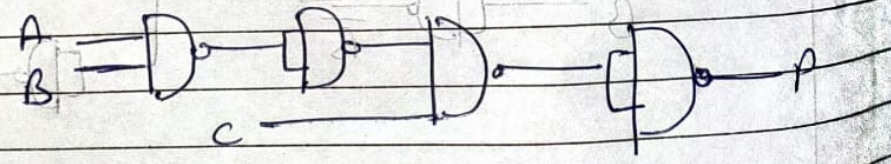
So O/p P to represent bus travelling at 60 kmph is

$$P = A \cdot B \cdot C$$

$$P = \overline{\overline{ABC}}$$

$$P = \overline{\overline{\overline{AB}\,C}}$$

$$\Rightarrow \text{not}[\text{nand}\{\{\text{not}(\text{nand}\,AB)\}.C\}]$$



14

Date.

Que 14

Restating the problem :-

i) If the marks in all subjects are greater than or = to 50 (A = 1, else A = 0) and if atleast one of them is greater than or equal to 60 (B = 1 else B = 0)

ii) If marks in all subj >= 40 (C = 1 else C = 0) & if atleast 2 of them is >= 60 (D = 1 else D = 0)

iii) If marks in atleast 2 subj are >= 40 (E = 1 else E = 0) & if atleast one of them is >= 60 (F = 1, else F = 0) & if marks in all subj are >= 35 (G = 1 else G = 0)

Student will pass (P = 1, else P = 0)

Thus $\boxed{P = AB + CD + E \cdot F \cdot G}$