Offline - 3

1 bit full Subtractor

Given

P	minuend
Q	Subtrahend
R	previous borrow
D	Difference
B	Output borrow

truth table

P	Q	R	D	B
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

K-map for minimal sop form of

D :

P \ QR	00	01	11	10
0	0 m_0	1 m_1	0 m_3	1 m_2
1	1 m_4	0 m_5	1 m_7	0 m_6

$P'Q'R$ $P'QR'$

$PQ'R'$ PQ

$$\therefore D = PQR + P'Q'R + P'QR' + PQ'R'$$

$$= R(PQ + P'Q') + R'(P'Q + PQ')$$

$$= R \cdot \overline{P \oplus Q} + R' \cdot P \oplus Q$$

$$= P \oplus Q \oplus R$$

$$\left(A \oplus B = \bar{A}B + A\bar{B} \right)$$

$$\left(\overline{A \oplus B} = \bar{A}\bar{B} + AB \right)$$

Logical Expression for B

$$B = P'Q'R + P'QR' + P'QR + PQR$$

$$= P'Q'R + PQR + P'QR' + P'QR$$

$$= R(P'.Q' + P.Q) + P'Q(R' + R)$$

$$= R(\overline{P \oplus Q}) + P'Q$$