Digital engineering 1nd report solutions

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<table>
<tr><th>1.3(1)</th><th>1.3(2)</th></tr>
<tr><td>
Convert $3BA.25_{14}$ to base 6.

First convert $3BA.25_{14}$ to a decimal number.

$3BA.25_{14} = (3\times14^2)+(B\times14^1)+(A\times14^0)+(2\times14^{-1})+(5\times14^{-2})$
$= (3\times14^2)+(11\times14^1)+(10\times14^0)+(2\times14^{-1})+(5\times14^{-2})$
$= 588+154+10+0.1428+0.0255$
$= 752.1683_{10}$

$6\,/\,752$
$6\,/\,125$ rem. $= 752-(6\times125)=2=a_0$
$6\,/\,20$ rem. $= 125-(6\times20)=5=a_1$
$6\,/\,3$ rem. $= 20-(6\times3)=2=a_2$
0 rem. $= 3-(6\times0)=3=a_3$

The base-6 number of integer part is,
$752_{10} = (a_3a_2a_1a_0)_6$
$= 3252_6$
</td><td>
$F_0 = 0.1683$, $\times6$, 1.0098, $(a_{-1}=1)$
$F_1 = 0.0098$, $\times6$, 0.0588, $(a_{-2}=0)$
$F_2 = 0.0588$, $\times6$, 0.3528, $(a_{-3}=0)$
$F_3 = 0.3528$, $\times6$, 2.1168, $(a_{-4}=2)$

The base-6 number of fractional part is,
$0.168_{10} = (a_{-1}a_{-2}a_{-3}a_{-4})_6$
$= 0.1002_6$

Thus, the base-6 of $3BA.25_{14}$ is, $\boxed{3252.1002_6}$.
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<tr><th>1.11(1)</th><th>1.11(2)</th></tr>
<tr><td>
$\underbrace{101}_{5}\ \underbrace{111}_{7}\ \underbrace{010}_{2}\ \underbrace{100}_{4}\ .\ \underbrace{101}_{5}$

Thus, the octal equivalent of 101111010100.101_2 is $\boxed{5724.5_8}$.

$\underbrace{1011}_{B}\ \underbrace{1101}_{D}\ \underbrace{0100}_{4}\ .\ \underbrace{1010}_{A}$

Thus, the hexadecimal equivalent of 101111010100.101_2 is $\boxed{BD4.A_{16}}$.
</td><td>
Convert 5724.5_8 to decimal number.

$5724.5_8 = 5\times8^3+7\times8^2+2\times8^1+4\times8^0+5\times8^{-1}$
$= 2560+448+16+4+0.625$
$= 3028.625_{10}$

Hence the decimal equivalent of 5724.5_8 is $\boxed{3028.625_{10}}$.

Convert $BD4.A_{16}$ to decimal number.

$BD4.A_{16} = B\times16^2+D\times16^1+4\times16^0+A\times16^{-1}$
$= 11\times16^2+13\times16^1+4\times16^0+10\times16^{-1}$
$= 2816+208+4+0.625$
$= 3028.625_{10}$

Hence the decimal equivalent of $BD4.A_{16}$ is $\boxed{3028.625_{10}}$.
</td></tr>
<tr><th>1.11(3)</th><th>1.11(4)</th></tr>
<tr><td>
$\underbrace{100}_{4}\ \underbrace{001}_{1}\ \underbrace{101}_{5}\ \underbrace{111}_{7}\ .\ \underbrace{010}_{2}$

Thus, the octal equivalent of 100001101111.01_2 is $\boxed{4157.2_8}$.
</td><td></td></tr>
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$\underbrace{1000}_{8}\ \underbrace{0110}_{6}\ \underbrace{1111}_{F}\ .\ \underbrace{0100}_{4}$

Thus, the hexadecimal equivalent of 100001101111.01_2 is $\boxed{86F.4_{16}}$.

Convert 4157.2_8 to decimal number.

$$\begin{aligned}4157.2_8 &= 4\times8^3+1\times8^2+5\times8^1+7\times8^0+2\times8^{-1}\\ &= 2048+64+40+7+0.25\\ &= 2159.25_{10}\end{aligned}$$

Hence the decimal equivalent of 4157.2_8 is $\boxed{2159.25_{10}}$.

Convert $86F.4_{16}$ to decimal number.

$$\begin{aligned}86F.4_{16} &= 8\times16^2+6\times16^1+F\times16^0+4\times16^{-1}\\ &= 8\times16^2+6\times16^1+15\times16^0+4\times16^{-1}\\ &= 2048+96+15+0.25\\ &= 2159.25_{10}\end{aligned}$$

Hence the decimal equivalent of $86F.4_{16}$ is $\boxed{2159.25_{10}}$.

1.38 (a)

Addition using 1's complement for negative numbers

	1	1	0	1	0
+	0	1	0	1	1
(1)	0	0	1	0	1
				+	1
	0	0	1	1	0

1's complement : 00110

Addition using 2's complement for negative numbers

	1	1	0	1	0
+	0	1	1	0	0
(1)	0	0	1	1	0

2's complement : 00110

no overflow

<table>
<tr><th>1.38 (b)</th><th>1.38 (c)</th></tr>
<tr><td>Addition using 1's complement
for negative numbers

0 1 0 1 1
+ 0 0 1 1 1
1 0 0 1 0
1's complement : 01110

Addition using 2's complement
for negative numbers

0 1 0 1 1
+ 0 1 0 0 0
1 0 0 1 1
2's complement : 10011
an overflow</td><td>Addition using 1's complement
for negative numbers

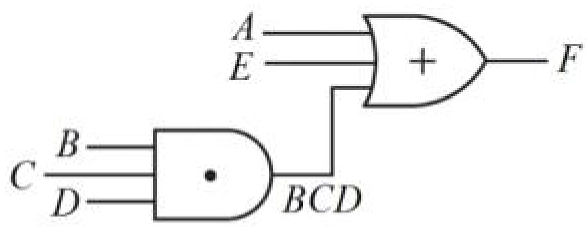
1 0 0 0 1
+ 1 0 1 0 1
(1) 0 0 1 1 0
+ 1
0 0 1 1 1
1's complement : 00111

Addition using 2's complement
for negative numbers

1 0 0 0 1
+ 1 0 1 1 0
(1) 0 0 1 1 1
2's complement : 01111
an overflow</td></tr>
<tr><th>1.38 (d)</th><th>2.4 (a)</th></tr>
<tr><td>Addition using 1's complement
for negative numbers

1 0 1 0 1
+ 0 0 1 0 1
1 1 0 1 0
1's complement : 11010

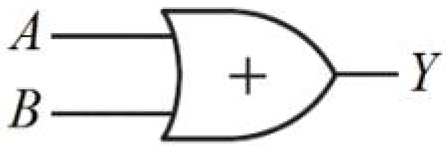
Addition using 1's complement
for negative numbers

1 0 1 0 1
+ 0 0 1 1 0
1 1 0 1 1</td><td>$F = (A+E)+(BCD)$
$= A+E+BCD$
Design a simpler circuit having the same output.
</td></tr>
</table>

<table>
<tr><td>2's complement : 11011
no overflow</td><td></td></tr>
<tr><td>2.4 (b)</td><td>2.6 (a)</td></tr>
<tr><td>

$Y = B + A$
$= A + B$

Design a simpler circuit having the same output.



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(a)

Convert the expression into product-of-sums form.

$AB + C'D'$
$\Rightarrow (AB) + (C')(D')$

Apply Distributive Law to the expression.

$\Rightarrow (AB + C')(AB + D')$ $\quad$ $(\text{since } X + YZ = (X+Y)(X+Z))$

Apply Distributive Law to the expression.

$\Rightarrow (A + C')(B + C')(A + D')(B + D')$ $\quad$ $(\text{since } X + YZ = (X+Y)(X+Z))$

Thus, the product-of-sums form is,

$\boxed{AB + C'D' = (A + C')(B + C')(A + D')(B + D')}$.

</td></tr>
<tr><td>2.6 (b)</td><td>2.6 (c)</td></tr>
<tr><td>

Convert the expression into product-of-sums form.

$WX + WY'X + ZYX$
$\Rightarrow WX(1 + Y') + ZYX$

Apply Operations with 0 and 1 to the expression.

$\Rightarrow WX(1) + ZYX$ $\quad$ $(\text{since } 1 + A = 1)$

Apply Operations with 0 and 1 to the expression.

$\Rightarrow WX + ZYX$ $\quad$ $(\text{since } 1.A = A)$
$\Rightarrow X(W + ZY)$

Apply Distributive Law to the expression.

$\Rightarrow X(W + Y)(W + Z)$ $\quad$ $(\text{since } A + BC = (A+B)(A+C))$

Thus, the product-of-sums form is,

$\boxed{WX + WY'X + ZYX = X(W + Y)(W + Z)}$.

</td><td>

Convert the expression into product-of-sums form.

$A'BC + EF + DEF'$
$\Rightarrow A'BC + E(F + DF')$

Apply Distributive Law to the expression.

$\Rightarrow A'BC + E(F + D)(F + F')$ $\quad$ $(\text{since } X + YZ = (X+Y)(X+Z))$

Apply Laws of complementarity to the expression.

$\Rightarrow A'BC + E(F + D)(1)$ $\quad$ $(\text{since } X + X' = 1)$

Apply Operations with 0 and 1 to the expression.

$\Rightarrow A'BC + (E)(F + D)$ $\quad$ $(\text{since } 1.X = X)$

Apply Distributive Law to the expression.

$\Rightarrow (A'BC + E)(A'BC + F + D)$ $\quad$ $(\text{since } X + YZ = (X+Y)(X+Z))$

Apply Distributive Law to the expression.

$\Rightarrow (A' + E)(B + E)(C + E)(A' + F + D)(B + F + D)(C + F + D)$
$(\text{since } X + YZ = (X+Y)(X+Z))$

Thus, the product-of-sums form is,

$\boxed{A'BC + EF + DEF' = (A' + E)(B + E)(C + E)(A' + F + D)(B + F + D)(C + F + D)}$.

</td></tr>
<tr><td>2.6 (d)</td><td>2.6 (e)1</td></tr>
<tr><td></td><td></td></tr>
</table>

Convert the expression into product-of-sums form.

$XYZ + W'Z + XQ'Z$
$\Rightarrow Z(XY + W' + XQ')$
$\Rightarrow Z(W' + XY + XQ')$
$\Rightarrow Z(W' + X(Y + Q'))$

Apply Distributive Law to the expression.

$\Rightarrow Z(W' + X)(W' + Y + Q')$ $\quad$ (since $A + BC = (A+B)(A+C)$)

Thus, the product-of-sums form is,

$\boxed{XYZ + W'Z + XQ'Z = Z(W' + X)(W' + Y + Q')}$.

Convert the expression into product-of-sums form.

$ACD' + C'D' + A'C$
$\Rightarrow (AC + C')D' + A'C$

Apply Distributive Law to the expression.

$\Rightarrow (A + C')(C + C')D' + A'C$ $\quad$ (since $X + YZ = (X+Y)(X+Z)$)

Apply Laws of complementarity to the expression.

$\Rightarrow (A + C')(1)D' + A'C$ $\quad$ (since $X + X' = 1$)

Apply Operations with 0 and 1 to the expression.

$\Rightarrow (A + C')D' + A'C$ $\quad$ (since $1.X = X$)

Apply Distributive Law to the expression.

$\Rightarrow (A + C' + A'C\ )(D' + A'C)$ $\quad$ (since $X + YZ = (X+Y)(X+Z)$)

Apply Distributive Law to the expression.

$\Rightarrow (A + C' + A')(A + C' + C)(D' + A')(D' + C)$
(since $X + YZ = (X+Y)(X+Z)$)

2.6 (e)2

Further simplification as follows.

$\Rightarrow (A + A' + C')(A + C' + C)(D' + A')(D' + C)$

Apply Laws of complementarity to the expression.

$\Rightarrow (1 + C')(A + 1)(D' + A')(D' + C)$ $\quad$ (since $X + X' = 1$)

Apply Operations with 0 and 1 to the expression.

$\Rightarrow (1)(1)(D' + A')(D' + C)$ $\quad$ (since $1 + X = 1$)

Apply Operations with 0 and 1 to the expression.

$\Rightarrow (D' + A')(D' + C)$ $\quad$ (since $1.X = X$)

Thus, the product-of-sums form is,

$\boxed{ACD' + C'D' + A'C = (D' + A')(D' + C)}$.

2.6 (f)

Convert the expression into product-of-sums form.

$A + BC + DE$
$\Rightarrow (A + BC) + DE$

Apply Distributive Law to the expression.

$\Rightarrow (A + B)(A + C) + DE$ $\quad$ (since $X + YZ = (X+Y)(X+Z)$)

Apply Distributive Law to the expression.

$\Rightarrow (A + B + DE\ )(A + C + DE\ )$ $\quad$ (since $X + YZ = (X+Y)(X+Z)$)

Apply Distributive Law to the expression.

$\Rightarrow (A + B + D)(A + B + E)(A + C + D)(A + C + E)$
(since $X + YZ = (X+Y)(X+Z)$)

Thus, the product-of-sums form is,

$\boxed{A + BC + DE = (A + B + D)(A + B + E)(A + C + D)(A + C + E)}$.

2.8(a)

$$F = AB\left((C')' + D'\right)$$
$$= AB(C + D')$$
$$= ABC + ABD'$$

2.8(b)

$$F = A'(B' + CD')$$
$$= A'B' + A'CD'$$

2.8(c)

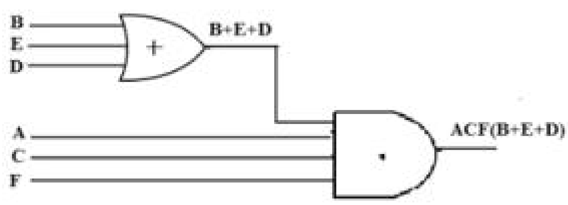
$$F = (A'B + C')(0 + BC'A')$$
$$= (A'B + C')(BC'A')$$
$$= BC'A' + BC'A' \qquad (\text{Since, } XX = X)$$
$$= A'BC'(1+1)$$

$$= A'BC' \qquad (\text{Since, } 1+1 = 1)$$

2.14(a)

ABCF + ACEF + ACDF

= ACF (B + E + D)

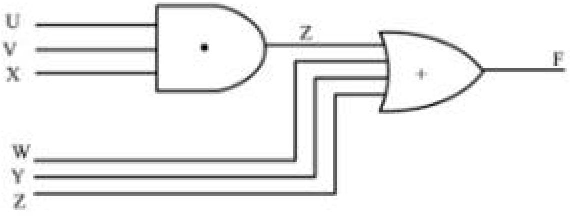


2.14(b)

(V + W + Y + Z) (U + W + Y + Z) (W + X + Y + Z)

Using (X + Y) (X + Z) = X + YZ [Distributive law]

= (W + Y + Z + UVX)



2.20(a)

$$F = D(A' + B')C + DAC'$$

$$F = D\left[(A' + B')C + AC'\right]$$

2.20(b)

$$F = D\left[(A' + B')C + AC'\right]$$
$$= D[A'C + B'C + AC']$$
$$= A'CD + B'CD + AC'D$$

2.20(c)

$$F = D\left[(A' + B') + A\right]\left[(A' + B') + C'\right][C + A][C + C']$$
$$= D[A' + A + B'][A' + B' + C'][C + A][1] \qquad (\text{since } X + X' = 1)$$
$$= D[1 + B'][A' + B' + C'][C + A][1]$$

$$= D[1][A' + B' + C'][C + A][1]$$
$$= D[A' + B' + C'][A + C] \qquad (\text{since } X.1 = X)$$

<table>
<tr><th>2.27</th><th>2.30</th></tr>
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F = (V + W + X) (V + X + Y) (V + Z)

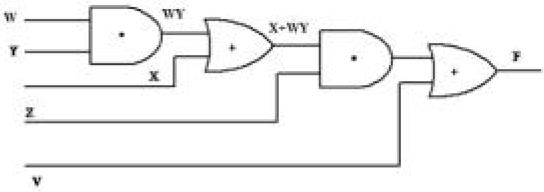
= (V + X + W) (V + X + Y) (V + Z)

Using (A + B) (A + C) = A + BC [Distributive law 8D]

= (V + X + WY) (V + Z)

= [V + (X + WY) · Z]

$\boxed{= V + (X + WY)Z}$



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$F = [(X + Y')Z] + X'YZ'$
$= (XZ + Y'Z) + X'YZ'$

$G = (X + Y' + Z')(X' + Z)(Y + Z)$
$= (XX' + Y'X' + Z'X' + XZ + Y'Z + Z'Z)(Y + Z)$
$= (0 + Y'X' + Z'X' + XZ + Y'Z + 0)(Y + Z)$ Since $AA' = 0$
$= (YY'X' + YZ'X' + YXZ + YY'Z + ZY'X' + ZZ'X' + ZXZ + ZY'Z)$

$= (0 + YZ'X' + YXZ + 0 + ZY'X' + 0 + ZXZ + ZY'Z)$ Since $AA' = 0$
$= X'YZ' + XYZ + X'Y'Z + XZ + Y'Z$ Since $AA = A$
$= X'YZ' + XZ(Y + 1) + Y'Z(X' + 1)$
$= X'YZ' + XZ(1) + Y'Z(1)$ Since $(A + 1) = 1$

$G = X'YZ' + XZ + Y'Z$ ...... (2)

$\boxed{F = G}$

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