Homework 1 Solution

1-6

11 *1 Bits* >>>> 2^{11} -1 = 2047

25 *1 Bits* >>>> 2^{25} -1 = 33,554,431

1-7.*

$(1001101)_2 = 2^6 + 2^3 + 2^2 + 2^0 = 77$

$(1010011.101)_2 = 2^6 + 2^4 + 2^1 + 2^0 + 2^{-1} + 2^{-3} = 83.625$

$(10101110.1001)_2 = 2^7 + 2^5 + 2^3 + 2^2 + 2^1 + 2^{-1} + 2^{-4} = 174.5625$

1-8.

2|193	1	→ 11000001
2|96	0	
2|48	0	
2|24	0	
2|12	0	
2|6	1	
2|1	1	
0		

2|751	1	→ 1011101111
2|375	1	
2|187	1	
2|93	1	
2|46	0	
2|23	1	
2|11	1	
2|5	1	
2|2	0	
2|1	1	
0		

2|2007	1	→ 11111010111
2|1003	1	
2|501	1	
2|250	0	
2|125	1	
2|62	0	
2|31	1	
2|15	1	
2|7	1	
2|3	1	
2|1	1	
0		

2|19450	0	→ 100101111111010
2|9725	1	
2|4862	0	
2|2431	1	
2|1215	1	
2|607	1	
2|303	1	
2|151	1	
2|75	1	
2|37	1	
2|18	0	
2|9	1	
2|4	0	
2|2	0	
2|1	1	
0		

1-9.*

Decimal	Binary	Octal	Hexadecimal
369.3125	101110001.0101	561.24	171.5
189.625	10111101.101	275.5	BD.A
214.625	11010110.101	326.5	D6.A
62407.625	1111001111000111.101	171707.5	F3C7.A

1-10.*

a)

8|7562	2	→ 16612
8|945	1	
8|118	6	
8|14	6	
8|1	1	
0		

$0.45 \times 8 = 3.6 \Rightarrow 3$
$0.60 \times 8 = 4.8 \Rightarrow 4$
$0.80 \times 8 = 6.4 \Rightarrow 6$
$0.20 \times 8 = 3.2 \Rightarrow 3$ → 3463

$(7562.45)_{10} = (16612.3463)_8$

b) $(1938.257)_{10} = (792.41CB)_{16}$

c) $(175.175)_{10} = (10101111.001011)_2$

1-11.*

a) $(673.6)_8 = (110\ 111\ 011.110)_2$
$= (1BB.C)_{16}$

b) $(E7C.B)_{16} = (1110\ 0111\ 1100.1011)_2$
$= (7174.54)_8$

c) $(310.2)_4 = (11\ 01\ 00.10)_2$
$= (64.4)_8$

1-15.

a)

0	1	2	3	4	5	6	7	8	9
A	B	C	D	E	F	G	H	I	J

b)

$$\begin{array}{r|l} 20|\underline{2007} & 7 \\ 20|\underline{100} & 0 \\ 20|\underline{5} & 5 \\ 0 & \end{array} \rightarrow 507_{20}$$

c) $(BCI.G)_{20} = 11 \times 20^2 + 12 \times 20^1 + 18 \times 20^0 + 16 \times 20^{-1} = (4658.8)_{10}$

1-16.*

a) $(\text{BEE})_r = (2699)_{10}$

$11 \times r^2 + 14 \times r^1 + 14 \times r^0 = 2699$

$11 \times r^2 + 14 \times r - 2685 = 0$

By the quadratic equation: $r = 15$ or ≈ -16.27

ANSWER: $r = 15$

b) $(365)_r = (194)_{10}$

$3 \times r^2 + 6 \times r^1 + 5 \times r^0 = 194$

b) $(365)_r = (194)_{10}$

$3 \times r^2 + 6 \times r^1 + 5 \times r^0 = 194$

$3 \times r^2 + 6 \times r - 189 = 0$

By the quadratic equation: $r = -9$ or 7

ANSWER: r = 7

1-18*

a) $(0100\ 1000\ 0110\ 0111)_{BCD} = (4867)_{10} = (1001100000011)_2$

b) $(0011\ 0111\ 1000.0111\ 0101)_{BCD} = (378.75)_{10} = (101111010.11)_2$

1-19*

$(694)_{10} = (0110\ 1001\ 0100)_{BCD}$

$(835)_{10} = (1000\ 0011\ 0101)_{BCD}$

	1 ←		
	0110	1001	0100
	+1000	+0011	+0101
	1111	1100	1001
	+0110	+0110	+0000
0001	0101	1 0010	1001

1-20*

(a)

	10^1	10^0		
	0111	1000		
Move R	011	1100	0	10^0 column > 0111
Subtract 3		-0011		
	011	1001	0	
Subtract 3		-0011		
	01	1001		
Move R	0	1100	110	10^0 column > 0111
Subtract 3		-0011		
	0	1001	110	
Move R		0100	1110	
Move R		010	01110	
Move R		01	001110	
Move R		0	1001110	Leftmost 1 in BCD number shifted out: Finished

(b)

	10^2	10^1	10^0		
	0011	1001	0111		
Move R	001	1100	1011	1	10^1 and 10^0 columns > 0111
Subtract 3		-0011	-0011		
	001	1001	1000	1	
Move R	00	1100	1100	01	10^1 and 10^0 columns > 0111
Subtract 3		-0011	-0011		
	00	1001	1001	01	
Move R	0	0100	1100	101	10^0 column > 0111
Subtract 3			-0011		
	0	0100	1001		
Move R		0010	0100	1101	
Move R		001	0010	01101	
Move R		00	1001	001101	100 column > 0111
Subtract 3			-0011		
		00	0110	001101	
Move R		0	0011	0001101	
Move R			0001	10001101	
Move R			000	110001101	Leftmost 1 in BCD number shifted out: Finished

1-22.

From Table 1-5, complementing the bit B_6 will switch an uppercase letter to a lower case letter and vice versa.

1-24.

1000111 G
1101111 o
0100000
1000010 B
1100001 a
1100100 d
1100111 g
1100101 e
1110010 r
1110011 s
0100001 !

1-25.*

a) $(11111111)_2$

b) $(0010\ 0101\ 0101)_{BCD}$

c) $011\ 0010 \quad 011\ 0101 \quad 011\ 0101_{ASCII}$

d) $0011\ 0010 \quad 1011\ 0101 \quad 1011\ 0101_{ASCII\ with\ Odd\ Parity}$

1-26.

Binary Numbers from $(32)_{10}$ to $(47)_{10}$ with Odd and Even Parity

Decimal	32	33	34	35	36	37	38	39
(a) Odd	100000 0	100001 1	100010 1	100011 0	100100 1	100101 0	100110 0	100111 1
(b) Even	100000 1	100001 0	100010 0	100011 1	100100 0	100101 1	100110 1	100111 0
Decimal	40	41	42	43	44	45	46	47
(a) Odd	101000 1	101001 0	101010 0	101011 1	101100 0	101101 1	101110 1	101111 0
(b) Even	101000 0	101001 1	101010 1	101011 0	101100 1	101101 0	101110 0	101111 1

1-27.

Gray Code for Hexadecimal Digits

Hex	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Gray	0000	0001	0011	0010	0110	0111	0101	0100	1100	1101	1111	1110	1010	1011	1001	1000

CHAPTER 2

2-1.*

a) $\overline{XYZ} = \overline{X} + \overline{Y} + \overline{Z}$

Verification of DeMorgan's Theorem

X	Y	Z	XYZ	$\overline{XYZ}$	$\overline{X}+\overline{Y}+\overline{Z}$
0	0	0	0	1	1
0	0	1	0	1	1
0	1	0	0	1	1
0	1	1	0	1	1
1	0	0	0	1	1
1	0	1	0	1	1
1	1	0	0	1	1
1	1	1	1	0	0

b) $X + YZ = (X + Y) \cdot (X + Z)$

The Second Distributive Law

X	Y	Z	YZ	$X+YZ$	$X+Y$	$X+Z$	$(X+Y)(X+Z)$
0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0
0	1	0	0	0	1	0	0
0	1	1	1	1	1	1	1
1	0	0	0	1	1	1	1
1	0	1	0	1	1	1	1
1	1	0	0	1	1	1	1
1	1	1	1	1	1	1	1

c) $\overline{X}Y + \overline{Y}Z + X\overline{Z} = X\overline{Y} + Y\overline{Z} + \overline{X}Z$

X	Y	Z	$\overline{X}Y$	$\overline{Y}Z$	$X\overline{Z}$	$\overline{X}Y+\overline{Y}Z+X\overline{Z}$	$X\overline{Y}$	$Y\overline{Z}$	$\overline{X}Z$	$X\overline{Y}+Y\overline{Z}+\overline{X}Z$
0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	1	0	0	1	1
0	1	0	1	0	0	1	0	1	0	1
0	1	1	1	0	0	1	0	0	1	1
1	0	0	0	0	1	1	1	0	0	1
1	0	1	0	1	0	1	1	0	0	1
1	1	0	0	0	1	1	0	1	0	1
1	1	1	0	0	0	0	0	0	0	0

2-2.*

a) $\overline{X}\overline{Y} + \overline{X}Y + XY = \overline{X} + Y$

$= (\overline{X}Y + \overline{X}\overline{Y}) + (\overline{X}Y + XY)$

$= \overline{X}(Y + \overline{Y}) + Y(X + \overline{X})$

$= \overline{X} + Y$

b) $\overline{A}B + \overline{B}\overline{C} + AB + \overline{B}C = 1$

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

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

2-6.

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

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

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

b) $\overline{(A + B + C)}\,\overline{(ABC)}$

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

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

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

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

d) $\bar{A}\bar{B}D + \bar{A}\bar{C}D + BD$

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

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

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

e) $(\overline{\bar{A} + B})\,\overline{(\bar{A} + \bar{C})}\,\overline{(A\bar{B}C)}$

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

$= 0$

$= \overline{W}X\overline{Z} + \overline{W}XZ + WX = \overline{W}X + WX = X$

d) $(AB + \overline{A}\,\overline{B})(\overline{C}\,\overline{D} + CD) + \overline{AC} = AB\overline{C}\,\overline{D} + ABCD + \overline{A}\,\overline{B}CD + \overline{A}\,\overline{B}\,\overline{C}\,\overline{D} + \overline{A} + \overline{C}$

$= ABCD + \overline{A} + \overline{C} = \overline{A} + \overline{C} + A(BCD) = \overline{A} + \overline{C} + C(BD) = \overline{A} + \overline{C} + BD$

2-8.

a) $F = A\overline{B}C + \overline{A}\,\overline{C} + AB$

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

b) $\overline{\overline{F}} = \overline{\overline{A\overline{B}C + \overline{A}\,\overline{C} + AB}}$

$= \overline{\overline{(A\overline{B}C)}\;\overline{(\overline{A}\,\overline{C})}\;\overline{(AB)}}$

2-9.*

a) $\overline{F} = (\overline{A} + B)(A + \overline{B})$

b) $\overline{F} = ((V + \overline{W})\overline{X} + \overline{Y})Z$

c) $\overline{F} = [\overline{W} + \overline{X} + (Y + \overline{Z})(\overline{Y} + Z)][W + X + Y\overline{Z} + \overline{Y}Z]$

d) $\overline{F} = \overline{A}B\overline{C} + (A + B)\overline{C} + \overline{A}(B + C)$

2-10.*

Truth Tables a, b, c

X	Y	Z	a
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

A	B	C	b
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

W	X	Y	Z	c
0	0	0	0	0
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	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

a) Sum of Minterms: $\overline{X}YZ + X\overline{Y}Z + XY\overline{Z} + XYZ$

Product of Maxterms: $(X + Y + Z)(X + Y + \overline{Z})(X + \overline{Y} + Z)(\overline{X} + Y + Z)$

b) Sum of Minterms: $\overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}C + \overline{A}BC + ABC$

Product of Maxterms: $(A + \overline{B} + C)(\overline{A} + B + C)(\overline{A} + B + \overline{C})(\overline{A} + \overline{B} + C)$

c) Sum of Minterms: $\overline{W}\,\overline{X}Y\overline{Z} + \overline{W}XY\overline{Z} + W\overline{X}Y\overline{Z} + WX\overline{Y}\,\overline{Z} + WX\overline{Y}Z + WXY\overline{Z} + WXYZ$

Product of Maxterms: $(W + X + Y + Z)(W + X + Y + \overline{Z})(W + X + \overline{Y} + \overline{Z})$
$(W + \overline{X} + Y + Z)(W + \overline{X} + Y + \overline{Z})(W + \overline{X} + \overline{Y} + \overline{Z})$
$(\overline{W} + X + Y + Z)(\overline{W} + X + Y + \overline{Z})(\overline{W} + X + \overline{Y} + \overline{Z})$

2-11.

a) $E = \Sigma m(1, 2, 4, 6) = \Pi M(0, 3, 5, 7)$, $F = \Sigma m(0, 2, 4, 7) = \Pi M(1, 3, 5, 6)$

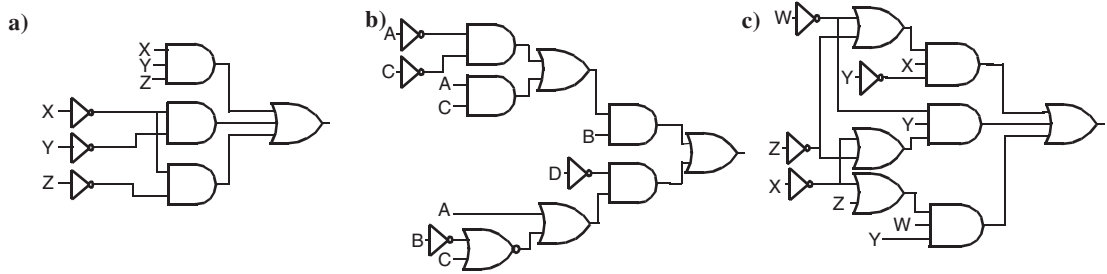
b) $\overline{E} = \Sigma m(0, 3, 5, 7)$, $\overline{F} = \Sigma m(1, 3, 5, 6)$

$= (A + B + C)(A + B + D)(A + C + D)(B + E)(B + F)$ p.o.s.

$(A + B\overline{C} + CD)(\overline{B} + EF) = A(\overline{B} + EF) + B\overline{C}(\overline{B} + EF) + CD(\overline{B} + EF)$

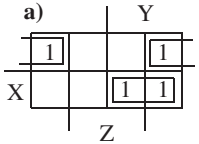
$= A\overline{B} + AEF + B\overline{C}EF + \overline{B}CD + CDEF$ s.o.p.

2-13.

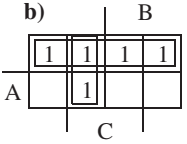


2-14.

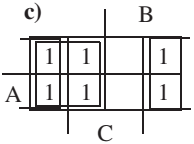
2-15. *



$\overline{X}\overline{Z} + XY$

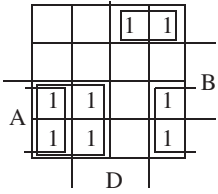


$\overline{A} + C\overline{B}$

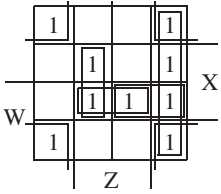


$\overline{B} + \overline{C}$

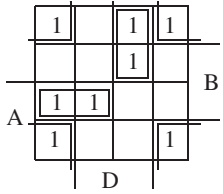
2-16.



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



$Y\bar{Z} + \bar{X}\bar{Z} + X\bar{Y}Z + (WXZ \text{ or } WXY)$



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

2-17.

2-19.*

a) $Prime = XZ, WX, \overline{X}\overline{Z}, W\overline{Z}$
$Essential = XZ, \overline{X}\overline{Z}$

b) $Prime = CD, AC, \overline{B}\overline{D}, \overline{A}BD, \overline{B}C$
$Essential = AC, \overline{B}\overline{D}, \overline{A}BD$

c) $Prime = AB, AC, AD, B\overline{C}, \overline{B}D, \overline{C}D$
$Essential = AC, B\overline{C}, \overline{B}D$

2-20.

a) $Prime = \overline{X}Y, \overline{X}\overline{Z}, W\overline{Y}\overline{Z}, WX\overline{Y}, X\overline{Y}Z, \overline{W}XZ, \overline{W}YZ$
$Essential = \overline{X}Y, \overline{X}\overline{Z}$
$F = \overline{X}Y + XZ + WX\overline{Y} + \overline{W}XZ$

b) $Prime = \overline{A}B\overline{C}, \overline{A}CD, ABC, A\overline{C}D, BD$
$Essential = \overline{A}B\overline{C}, \overline{A}CD, ABC, A\overline{C}D$
$Redundant = BD$
$F = \overline{A}B\overline{C} + \overline{A}CD + ABC + A\overline{C}D$

c) $Prime = \overline{Y}\overline{Z}, W\overline{Y}, \overline{W}\overline{Z}, WXZ, XYZ, \overline{W}XY$
$Essential = W\overline{Y}, \overline{W}\overline{Z}$
$Redundant = \overline{Y}\overline{Z}$
$F = W\overline{Y} + \overline{W}\overline{Z} + XYZ$

2-23.

a) s.o.p. $\overline{A}\overline{B}\overline{C} + \overline{A}BD + ABC + A\overline{B}\overline{D}$

or $\overline{A}\overline{C}D + BCD + AC\overline{D} + \overline{B}\overline{C}\overline{D}$

p.o.s. $(A + B + \overline{C})(A + \overline{B} + D)(\overline{A} + \overline{B} + C)(\overline{A} + B + \overline{D})$

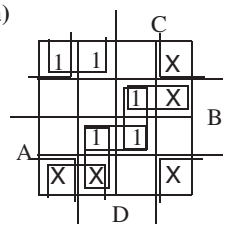
or $(A + \overline{C} + D)(\overline{B} + C + D)(\overline{A} + C + \overline{D})(B + \overline{C} + \overline{D})$

b) s.o.p. $\overline{Z} + \overline{W}X + \overline{X}\overline{Y}$

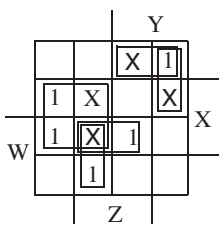
p.o.s. $(\overline{W} + \overline{X} + \overline{Z})(X + \overline{Y} + \overline{Z})$

2-24.

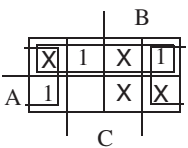
a)



b)



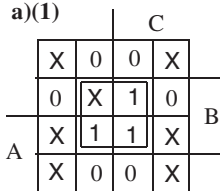
c)



$F = \overline{B}\overline{C} + BCD + ABD$ $F = X\overline{Y} + W\overline{Y}Z + WXZ + (\overline{W}\overline{X}Y \text{ or } \overline{W}Y\overline{Z})$ $F = \overline{A} + \overline{C}$

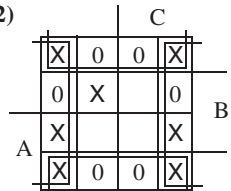
2-26.

a)(1)



$F = BD$

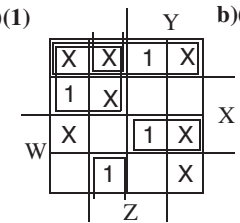
a)(2)



$\overline{F} = \overline{B} + \overline{D}$

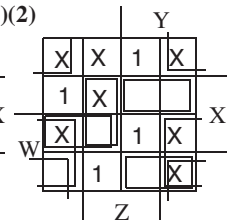
$F = BD$

b)(1)



$F = \overline{W}\,\overline{X} + \overline{W}\,\overline{Y} + \overline{X}\,\overline{Y}\,Z + W\,X\,Y$

b)(2)



$\overline{F} = (W\overline{Z}$ or $\overline{X}\,\overline{Z}) + \overline{W}XY + W\overline{X}Y + (WX\overline{Y}$ or $X\overline{Y}Z)$

$F = ((\overline{W} + Z)$ or $(X + Z))\,(W + \overline{X} + \overline{Y})(\overline{W} + X + \overline{Y}) + (\overline{W} + \overline{X} + Y)$ or $(\overline{X} + Y + \overline{Z})$

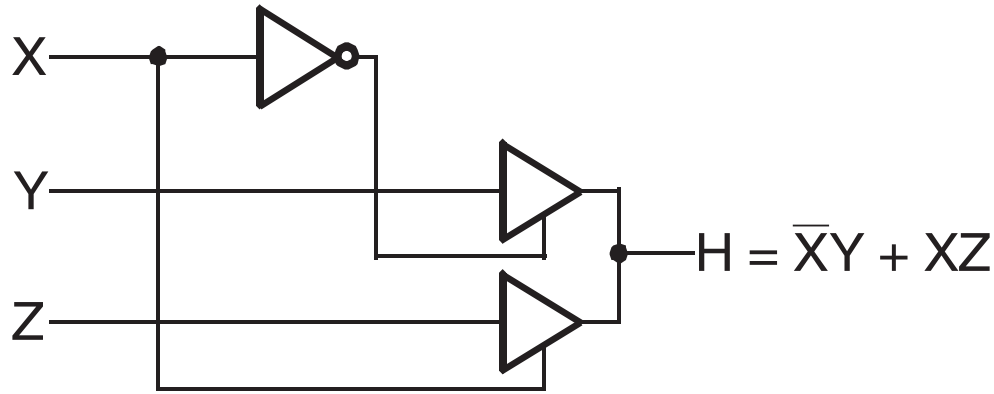
2-27.

a) $F = \overline{A}\,\overline{B}\,\overline{C}\,\overline{D} + \overline{A}B\overline{C} + A\,\overline{C}\,\overline{D} + ABD + ABC\overline{D} + \overline{B}C\overline{D}$

b) $F = \overline{A}\,\overline{C} + \overline{A}B + BD + AC + A\overline{B}$

2-34.

a)



b)