POSTAL BOOK PACKAGE 2025

ELECTRICAL ENGINEERING

CONVENTIONAL Practice Sets

CONTENTS

DIGITAL ELECTRONICS

1 CHAPTER Number Systems and Codes

Q.1 (i) Convert octal 756 to decimal.
(ii) Convert hexadecimal 3B2 to decimal.
(iii) Convert the long binary number 1001001101010001 to octal and to hexadecimal.

Solution:

(i) $(756)_8$

$$= 7 \times 8^2 + 5 \times 8^1 + 6 \times 8^0 = 448 + 40 + 6 = (494)_{10}$$

(ii) $(3B2)_{16}$

$$= 3 \times 16^2 + 11 \times 16^1 + 2 \times 16^0 \qquad \text{(put B = 11)}$$
$$= 768 + 176 + 2 = (946)_{10}$$

(iii)

$$\underbrace{0\ 0\ 1}_{1}\ \underbrace{0\ 0\ 1}_{1}\ \underbrace{0\ 0\ 1}_{1}\ \underbrace{1\ 0\ 1}_{5}\ \underbrace{0\ 1\ 0}_{2}\ \underbrace{0\ 0\ 1}_{1}$$
$$= (111521)_8$$

and

$$\underbrace{1\ 0\ 0\ 1}_{9}\ \underbrace{0\ 0\ 1\ 1}_{3}\ \underbrace{0\ 1\ 0\ 1}_{5}\ \underbrace{0\ 0\ 0\ 1}_{1}$$
$$= (9351)_{16}$$

Q.2 Show the value of all bits of a 12-bit register that holds the number equivalent to decimal 215 in
(a) binary (b) binary coded octal (c) binary coded hexadecimal and (d) binary coded decimal.

Solution:

(a) Binary

$$(215)_{10} = (11010111)_2$$

2	215	
2	107	1
2	53	1
2	26	1
2	13	0
2	6	1
2	3	0
	1	1

In a 12-bit register, it will be stored as: "0 0 0 0 1 1 0 1 0 1 1 1"

(b) Binary Coded Octal

$$(215)_{10} = (0327)_8 = 000\ \ 011\ \ 010\ \ 111$$

(c) Binary Coded Hexadecimal

$$(215)_{10} = (0D7)_{16} = 0000\ \ 1101\ \ 0111$$

(d) Binary Coded Decimal

In binary coded decimal, each decimal (0 to 9) digit is represented by 4-bit binary code.

$$(215)_{10} = 0010\ \ 0001\ \ 0101$$

Q.3 Consider the addition of numbers with different bases
$(x)_7 + (y)_8 + (w)_{10} + (z)_5 = (k)_9$
If $x = 36$, $y = 67$, $w = 98$ and $k = 241$, then z is

Solution:

$$(36)_7 = (27)_{10}\ ; \quad (67)_8 = (55)_{10}\ ; \quad (98)_{10} = (98)_{10}$$
$$(z)_5 = (z)_5$$
$$(241)_9 = (199)_{10}$$

$$(z)_5 = (199)_{10} - (27)_{10} - (55)_{10} - (98)_{10}$$

$$\begin{array}{c|c|c} 5 & 19 & 4 \\ \hline & 3 & \end{array}$$

$$(z)_5 = (19)_{10}$$

$$(z)_5 = (34)_5$$

$$\therefore \quad z = 34$$

Q.4 (a) Represent the 8620 into following codes:

(i) BCD (ii) Excess-3 (iii) 2421

(b) Find 7's complement of the given number $(2365)_7$

Solution:

(a) (i) Write binary equivalent of each decimal

8620 ⇒ 1000 0110 0010 0000

(ii) **Excess-3:** For excess 3, add 3 (binary 0011) to each BCD part.

Hence,

$$\begin{array}{cccc} 1000 & 0110 & 0010 & 0000 \\ +0011 & +0011 & +0011 & +0011 \\ \hline 1011 & 1001 & 0101 & 0011 \end{array}$$

(iii) 2421: It is a weighted binary code

There codes are minor image from the given dotted line.

As $(4)_{10}$ and $(5)_{10}$ make complementary pair.

Similarly $(3)_{10}$ and $(6)_{10}$ .... make the complementary pair.

Hence, 1110 1100 0010 0000.

Decimal digit	2	4	2	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	1	0	1	1
6	1	1	0	0
7	1	1	0	1
8	1	1	1	0
9	1	1	1	1

(b) For a value/number having a base of r,

then r's complement = $(r-1)$'s complement + 1

Hence, 7's complement of $(2365)_7$ = 6's complement + 1

$$\begin{array}{rl} 6\,6\,6\,6 & \\ -\,2\,3\,6\,5 & \\ \hline 4\,3\,0\,1 & \text{6's complement} \\ +\,1 & \\ \hline 4\,3\,0\,2 & \text{7's complement} \end{array}$$

Q.5 Perform the following conversions:

(i) $(3287.5100098)_{10}$ into octal (ii) $(675.625)_{10}$ into hexadecimal (iii) $(A72E)_{16}$ into octal

Solution:

(i) To convert $(3287.5100098)_{10}$ into octal:

- Integer part conversion,

$$\begin{array}{r|l} 8 & 3287 \\ \hline 8 & 410 - 7 \\ \hline 8 & 51 - 2 \\ \hline 8 & 6 - 3 \\ \hline & 0 - 6 \end{array}$$

$$(3287)_{10} = (6327)_8$$

- Fractional part conversion,

$$0.5100098 \times 8 = 4.0800784 \rightarrow 4$$
$$0.0800784 \times 8 = 0.6406272 \rightarrow 0$$
$$0.6406272 \times 8 = 5.1250176 \rightarrow 5$$
$$0.1250176 \times 8 = 1.0001408 \rightarrow 1$$
$$(0.5100098)_{10} = (0.4051...)_8$$

So, $(3287.5100098)_{10} = (6327.4051...)_8$

2 CHAPTER Digital Circuits

Q.1 **Write De Morgan's theorem, distributive law, absorption law and consensus theorem.**

Solution:

De Morgan theorem: (i) $\overline{(x+y)} = \bar{x} \cdot \bar{y}$ (ii) $\overline{(xy)} = \bar{x} + \bar{y}$

Distributive law: (i) $x(y + z) = xy + xz$ (ii) $x + yz = (x + y)(x + z)$

Absorption law: (i) $x + xy = x$ (ii) $x(x + y) = x$

Consensus theorem/redundancy theorem: $AB + \bar{A}C + BC = AB + \bar{A}C$

Q.2 **Find the dual of the following: (i) $F_1 = \bar{X}Y\bar{Z} + \bar{X}\bar{Y}Z$ (ii) $F_1 = X(\bar{Y}\bar{Z} + YZ)$**

Solution:

(i) We know that dual of AND is OR and vice versa.

Dual of F_1 can be obtained by making OR connection as AND and AND connection as OR.

Hence, Dual of $F_1 = (\bar{X} + Y + \bar{Z})(\bar{X} + \bar{Y} + Z)$

(ii) Similarly, Dual of $F_2 = X + (\bar{Y} + \bar{Z})(Y + Z)$

Q.3 **Express the Boolean function, $F = XY + X'Z$ as a POS (Product of Sum) form and finally express this in a convenient way form.**

Solution:

Given,

$$\begin{aligned}
F &= XY + X'Z = (XY + X')(XY + Z) \quad \text{[By distributive law]}\\
&= (X + X')(Y + X')(X + Z)(Y + Z)\\
&= (Y + X')(X + Z)(Y + Z)\\
&= (Y + X' + ZZ')(X + Z + YY')(Y + Z + XX')\\
&= (X' + Y + Z)(X' + Y + Z')(X + Y + Z)(X + Y' + Z)(X + Y + Z)\\
&\quad (X' + Y + Z)\\
&= (X + Y + Z)(X' + Y + Z)(X' + Y + Z')(X + Y' + Z)
\end{aligned}$$

$$\therefore \quad F = M_0 M_4 M_5 M_2$$

A convenient way to express this function is,

$$F(X, Y, Z) = \Pi M(0, 2, 4, 5)$$

The product symbol, Π denotes the ANDing of maxterms, the numbers are the maxterms of the function.

Q.4 **Expand $A + B\bar{C} + AB\bar{D} + ABCD$ to minterms and maxterms.**

Solution:

The given expression is a four-variable function. In the first terms A, the variables B, C and D are missing. So, multiply to by $(B+\bar{B})(C+\bar{C})(D+\bar{D})$. In the second term $B\bar{C}$, the variables A and D are missing. So, multiply it by $(A+\bar{A})(D+\bar{D})$. In the third term, $AB\bar{D}$, the variable C is missing So, multiply it by ($(C+\bar{C})$. In the fourth terms $ABCD$, all the variables are present. So, leave it as it is.