

Octal Number System

(2)

→ It is used by minicomputers.

→ Its base or radix is 8.

→ It has 8 independent symbols 0, 1, 2, 3, 4, 5, 6 and 7.

→ Since its base = 8 = 2^3

→ Every 3 bit of binary can be represented by octal digit.

→ An Octal = $1/3$ of Binary

→ Application: - expressing large Numbers.

It represents

(1) actual numerical data

(2) location in memory

(3) Instruction code

* Octal to Binary Conversion

(1) $(367.52)_8$ to Binary

3 6 7 . 5 2
0 1 1 1 1 0 1 1 . 1 0 1 0 1 0
 $(0 1 1 1 1 0 1 1 . 1 0 1 0 1 0)_2$

* Binary to Octal Conversion

① 1 1 0 1 0 1 1 0 1 0 1 0

1 1 0 1 0 1 1 0 1 0 1 0
6 5 5 2
 $(6552)_8$

Q2) convert $(10101111001.0111)_2$ to octal

before zero

After zero

0 10 101 11 00 , . 011 100

2 5 7 1 . 3 4 8

* Octal to Decimal conversion

Que - Ans

463 - 37

2056 - 1070

2057.64 - 1071.85

(1) convert $(4057.06)_8$ to decimal. 6534.04 - 3420.06

450

$$4057.06 = 4 \times 8^3 + 0 \times 8^2 + 5 \times 8^1 + 7 \times 8^0$$

$$+ 0 \times 8^{-1} + 6 \times 8^{-2}$$

$$= 2048 + 0 + 40 + 7 + 0 + 0.0937$$

$$= (2095.0937)_{10}$$

* Decimal to octal conversion

Q1) convert 3788 $(378.93)_{10}$ to octal

$$\begin{array}{r|l} 8 & 378 \\ \hline 8 & 47 \\ \hline 8 & 5 \\ \hline & 0 \end{array} \quad \begin{array}{l} 2 \\ 7 \\ 5 \end{array} \quad \uparrow \quad (572)_8$$

(Q2) $0.9378 = 7.44$

$0.4478 = 3.57$

$0.5278 = 4.16$

$0.1678 = 1.28$

$(572.7341)_8$

7341

Decimal to Octal Conversion

Ques - Ans
287 - 437

3956 - 7564

420.6 - 644.463

8476.47 - 20434.360

Ques - 93710 / 1208121

Ans - 7/4/4/1

Convert $(5497)_{10}$ to Binary

$$\begin{array}{r} 8 \overline{) 5497} \\ 8 \overline{) 607} \quad 1 \\ 8 \overline{) 85} \quad 7 \\ 8 \overline{) 10} \quad 5 \\ 8 \overline{) 1} \quad 2 \\ 1 \quad 0 \quad 1 \end{array}$$

$(12571)_8$

$= (00101010111001)_2$

Octal Addition

(1) By decimal method,

$$\begin{array}{r} 327.54 \\ 665.37 \\ \hline \end{array}$$

2) Add the digit in each column in decimal convert this sum into octal.

$$\begin{array}{r} 1 \quad 1 \quad 1 \quad 1 \\ 3 \quad 2 \quad 7 \quad 5 \quad 4 \\ 6 \quad 6 \quad 5 \quad 3 \quad 7 \\ \hline 1 \quad 0 \quad 1 \quad 5 \quad 1 \quad 3 \end{array}$$

$$7 + 4 = (11)_{10} = (13)_8$$

$$= \text{Sum} = 3 \text{ carry} = 1$$

$$5 + 3 + 1 = (9)_{10} = (11)_8$$

$$= \text{Sum} = 1, \text{ carry} = 1$$

$$7 + 1 + 5 = 13 = (15)_8 = \text{Sum} = 5$$

$$\text{carry} = 1$$

$$6 + 2 + 1 = (9)_{10} = (11)_8 \text{ (Sum} = 1, \text{ carry} = 1)$$

$$6 + 3 + 1 = (10)_{10} = (12)_8$$

$$\text{Sum} = 2 \\ \text{carry} = 1$$

$$\begin{array}{r} 0 \\ 6 \\ 6 \\ 6 \\ 0 \end{array}$$

$$\begin{array}{r} 0 \\ 6 \\ 6 \\ 6 \\ 0 \end{array}$$

* Octal subtraction.

$$\begin{array}{r} 178 \\ 2014 \\ - 1647 \\ \hline (0145)_8 \end{array}$$

$$\begin{aligned} 8 + 4 - 7 &= 10 - 7 = 3 \\ 8 - 4 &= 4 \\ 7 - 6 &= 1 \end{aligned}$$

Octal multiplication:-

$$\begin{array}{r} 5423 \\ 2703 \cdot 5 \\ \times 6 \\ \hline 1966 \cdot 56 \end{array}$$

(1) $6 \times 5 = (30)_{10} = (36)_8$
 (Carry = 6, carry = 3)

(2) $6 \times 3 = (18)_{10} = (22)_8 + (4)_8$
 $= (25)_8$

(3) $6 \times 6 = (36)_{10} = (44)_8$
 $= + (12)_8$
 $= (56)_8$

(4) $7 \times 6 = (42)_{10} = (52)_8$
 $= (52)_8 + (4)_8$
 $= (56)_8$

(5) $6 \times 2 = 12 = (14)_8 + (5)_8$
 $= (19)_8$

$$\begin{array}{r} 86 \\ 18074 \\ 2014 \\ - 1647 \\ \hline 5 \end{array}$$

1 $46 \times 4 = 230$

$267 \times 5 = 1623$

~~201450 x 2005~~

$$\begin{array}{r} 16 \\ 140 \\ - 104 \\ \hline 36 \end{array}$$

find 7's and 8's complement of following numbers

(a) 4015

$$\begin{array}{r} 7777 \\ - 4015 \\ \hline 3762 \quad 7's \\ + 1 \\ \hline 3763 \quad 8's \end{array}$$

(b) 2057.106

$$\begin{array}{r} 7777.777 \\ - 2057.106 \\ \hline 5720.671 \quad 7's \\ + 1 \\ \hline 5720.672 \quad 8's \end{array}$$

* Subtract (0236.43) from (5407.65) using 7's comp method.

$$\begin{array}{r} 7777.77 \\ 0236.43 \\ \hline 7541.34 \end{array}$$

$$\begin{array}{r} 1111 \\ 5407.65 \\ 7541.34 \\ \hline 1171.21 \end{array}$$

carry five

$$5171.22$$

Subtract 5407.65 from 0236.43 using 8's comp method.

$$\begin{array}{r} 0236.43 \\ 5407.65 \\ \hline 5666.08 \\ 3 \end{array}$$

$$\begin{array}{r} 8's \\ 7777.77 \\ - 5407.65 \\ \hline 2350.12 \\ + 1 \\ \hline 2350.13 \quad 8's \end{array}$$

$$\begin{array}{r} 0236.43 \\ + 2350.13 \\ \hline 2606.56 \end{array}$$

no carry Ans: -ve.

8's comp = 1

$$2606.56$$

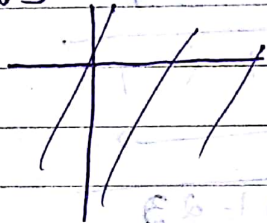
$$\begin{array}{r} 7777.77 \\ - 2606.56 \\ \hline 5171.21 \end{array}$$

$$-5171.22$$

Ex 10a

* convert following octal to decimal

(a) 463



463

$$= \begin{array}{ccc} 4 & 6 & 3 \\ 8^2 & 8^1 & 8^0 \end{array}$$

$$= 4 \times 8^2 + 6 \times 8^1 + 3 \times 8^0$$

$$= 4 \times 64 + 6 \times 8 + 3$$

$$= 256 + 48 + 3$$

$$= 307$$

$$(307)_{10}$$

$$\begin{array}{r} 63 \\ \times 48 \\ \hline 112 \\ 256 \\ \hline 307 \end{array}$$

$$\begin{array}{r} 307 \\ \div 8 \\ \hline 38 \\ \text{R } 3 \end{array}$$

$$\begin{array}{r} 357 \\ 8 \overline{) 257} \\ \underline{16} \\ 43 \\ \underline{40} \\ 37 \\ \underline{30} \\ 7 \end{array}$$
$$\begin{array}{r} 32 \\ 8 \overline{) 256} \\ \underline{24} \\ 16 \\ \underline{16} \\ 0 \end{array}$$
$$\begin{array}{r} 5 \overline{) 0.64} \\ \underline{0.60} \\ 0.04 \end{array}$$
$$\begin{array}{r} 53 \\ 0.64 \\ \hline 512 \end{array}$$

0.12

$$\begin{array}{r} 0.12 \\ 7 \overline{) 7.68} \\ \underline{7 9} \\ 6 \\ \underline{6 } \\ 8 \\ \underline{8} \\ 0 \end{array}$$
$$\begin{aligned} 0.64 \times 8 &= 5.12 \quad \downarrow \\ 0.12 \times 8 &= 0.96 \\ 0.96 \times 8 &= 7.68 \quad \uparrow \end{aligned}$$
$$(4011.507)_{10}$$

Addition: -

$$\begin{array}{r} 11 \\ 1247 \\ + 2053 \\ \hline 3322 \end{array}$$
$$\begin{array}{r} 273.56 \\ 425.07 \\ \hline 700.65 \end{array}$$
$$\begin{array}{r} 173 \\ 265 \\ \hline 460 \end{array}$$

7

8/8 0 1

Subtraction

(a)

$$\begin{array}{r} 58 \\ 64 \\ - 37 \\ \hline 25 \end{array}$$

$$8+4-7$$

(b)

$$\begin{array}{r} 402-175 \\ 388 \\ 482 \\ \hline 175 \\ 265 \end{array}$$

$$8+2-5$$

$$8+5-7 = 13-7$$

$$= 6$$

(c)

$$\begin{array}{r} 648 \\ 175.6 \\ - 47.7 \\ \hline 125.7 \end{array}$$

$$8+6-7 = 7$$

$$8+4-7 = 12-7$$

$$= 5$$

(d)

$$\begin{array}{r} 2775.78 \\ 3006.05 \\ - 2657.16 \\ \hline 0126.67 \end{array}$$

$$8+5-6 = 13-6$$

$$8+5-7 = 13-7 = 6$$

(e)

$$\begin{array}{r} 1758 \\ 2014 \\ - 16.47 \\ \hline 01645 \end{array}$$

$$8+4-7 = 12-7$$

$$8+0-4 = 8-4 = 4$$

$$\begin{array}{r} 2775.78 \\ 3006.05 \\ - 2657.16 \\ \hline 0126.67 \end{array}$$

$$8+5-6 = 13-6$$

$$8+5-7 = 13-7$$

$$= 6$$

$$\begin{array}{r} 2775.78 \\ 3006.05 \\ - 2657.16 \\ \hline 67 \end{array}$$

$$8+5-6$$

$$8+5-7$$

Octal Table

Decimal Number

Octal Number

0

0

1

1

2

2

3

3

4

4

5

5

6

6

7

7

8

10

9

11

10

12

11

13

12

14

13

15

14

16

15

17

16

20

17

21

18

22

19

23

20

24

21

25

22

26

23

27

24

30

25

31

Octal Addition

$$\begin{array}{r} 11 \\ 173 \\ + 265 \\ \hline 460 \end{array}$$

$$5 + 3 = 8_{10} = 10$$

$$7 + 6 + 1 = (14) = 16$$

$$\begin{array}{r} 11 \\ 1247 \\ + 2053 \\ \hline 3322 \end{array}$$

$$10 = 12$$

$$10 = 12$$

$$\begin{array}{r} 11 \\ 25.76. \\ + 16.57 \\ \hline 44.55 \end{array}$$

$$13 - 15$$

$$13 - 15$$

$$12 = 14$$

$$\begin{array}{r} 11 \\ 273.56 \\ + 425.07 \\ \hline 720.65 \end{array}$$

$$13 - 15$$

$$8 - 10$$

$$9 = 11$$

Subtraction

$$\begin{array}{r} 277.78 \\ 3006.05 \\ - 2657.16 \\ \hline 126.67 \end{array}$$

$$8 + 5 - 6 =$$

$$8 + 5 - 7 = 13 - 7 = 6$$

Octal Subtraction

$$\begin{array}{r} 58 \\ 504 \\ - 37 \\ \hline 25 \end{array}$$

$$8 + 4 - 7 = 5$$

(3)

$$\begin{array}{r} 8 \\ 648 \\ 175.6 \\ - 47.7 \\ \hline 125.7 \end{array}$$

$$8 + 6 - 7$$

$$8 + 4 - 7$$

$$\begin{array}{r} 258 \\ 258 \\ 8) - 462 \\ 175 \\ \hline 265 \end{array}$$

$$8 + 2 - 5$$

$$8 + 5 - 7$$

(4)

$$\begin{array}{r} 798 \\ 2885.88 \\ 3006.05 \\ - 2657.16 \\ \hline 0426.67 \end{array}$$

$$8 + 5 - 8$$

$$8 + 5 - 7 = 6$$

$$126.67$$

$$\begin{array}{r} 8 \\ 1708 \\ 2014 \\ - 1647 \\ \hline 145 \end{array}$$

$$8 + 4 - 7 =$$