1.3.1 Radix Divide Technique

(i) Divide the given integer successively by the required radix, noting the remainder at each step. The quotient at each step becomes the new dividend for subsequent division. Stop the division process when the quotient becomes zero.
(ii) Collect the remainders from each step (last to first) and place them left to right to form the required number.

The following examples illustrate the procedure.

Example 1.5

$(245)_{10} = (?)_2$ (i.e., convert $(245)_{10}$ to binary)

Required base — Remainders

$$
\begin{array}{r|rl}
2 & 245 & \\
2 & 122 & 1 \\
2 & 61 & 0 \\
2 & 30 & 1 \\
2 & 15 & 0 \\
2 & 7 & 1 \\
2 & 3 & 1 \\
2 & 1 & 1 \\
 & 0 & 1
\end{array}
\quad = (11110101)_2
$$

Here, 245 is first divided by 2, generating a quotient of 122 and a remainder of 1. Next 122 is divided, generating 61 as the quotient and 0 as the remainder. The division process is continued until the quotient is 0, with the remainders noted at each step. The remainder bits from each step (last to first) are then placed left to right to form the number in base 2.

To verify the validity of the radix divide technique, consider the polynomial representation of a four-bit integer $A = (a_4a_3a_2a_1)$:

$$A = \sum_{i=1}^{4} a_i \cdot r^i$$

This can be rewritten as

$$A = 2(2(2(a_3) + a_2) + a_1) + a_0$$

From this form, it can be seen that the bits of the binary number correspond to the remainder at each divide-by-two operation. Some examples follow.

1) from 10 to other base use Radix Divide Technique

Example 1.6

$$(245)_{10} = (?)_8$$

$$
\begin{array}{r|rl}
8 & 245 & \\
8 & 30 & 5 \\
8 & 3 & 6 \\
 & 0 & 3
\end{array}
\quad = (365)_8
$$

Example 1.7

$$(245)_{10} = (?)_{16}$$

$$
\begin{array}{r|rl}
16 & 245 & \\
16 & 15 & 5 = 5 \\
 & 0 & 15 = F
\end{array}
\quad = (F5)_{16}
$$

1.3.2 Radix Multiply Technique

As we move each position to the right of the radix point, the weight corresponding to each bit in the binary fraction is halved. The radix multiply technique uses this fact and multiplies the given decimal number by 2 (i.e., divides the given number by half) to obtain each fraction bit. The technique consists of the following steps:

(i) Successively multiply the given fraction by the required base, noting the integer portion of the product at each step. Use the fractional part of the product as the multiplicand for subsequent steps. Stop when the fraction either reaches 0 or recurs.
(ii) Collect the integer digits at each step from first to last and arrange them left to right.

If the radix multiplication process does not converge to 0, it is not possible to represent a decimal fraction in binary exactly. Accuracy, then, depends on the number of bits used to represent the fraction. Some examples follow.

Example 1.8

$$(.250)_{10} = (?)_2$$

$$
\begin{array}{r}
.25 \\
\times 2 \\
\hline
0.50 \\
\times 2 \\
\hline
1.00
\end{array}
\quad = (.01)_2
$$