1.15 Write the number 256.1875 in the 16-bit IDDD-643 standard that was introduced in Problem 1.13. Apply chopping if necessary.

Solution

According to the IDDD-643 standard:

- Since the number is positive, the first bit is 0
- The largest power of 2 that divides into 256.1875 is 8 since $2^8 = 256$. Thus,

$$\frac{256.1875}{2^8}\times 2^8 = \frac{256.1875}{256}\times 2^8 = 1.000732421875\times 2^8$$

- The exponent is 8. Adding a bias of 15, the value of the exponent that must be stored is 8+15 = 23. The number 23 in binary form is:

$$23 = 1\times 2^4 + 1\times 2^2 + 1\times 2^1 + 1\times 2^0 = 16 + 4 + 2 + 1$$

Thus the number 23 in binary form is 10111. Since 5 bits can be used to store the exponent 23 is stored as 10111.

- Next, the mantissa 0.000732421875 in binary form is:

$$2^{-11} + 2^{-12} \text{ or, } 0.000000000011$$

Since there are 10 bits of storage available, there is loss in precision because by chopping, the last two bits, 1 and 1 are lost. The 10-digit mantissa that is stored is then 0000000000. Thus, the number 256.1875 in the IDDD-643 standard is stored as: