Experiment No. 9
Implement Non-Restoring algorithm using c-programming
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Date of Performance:
Date of Submission:

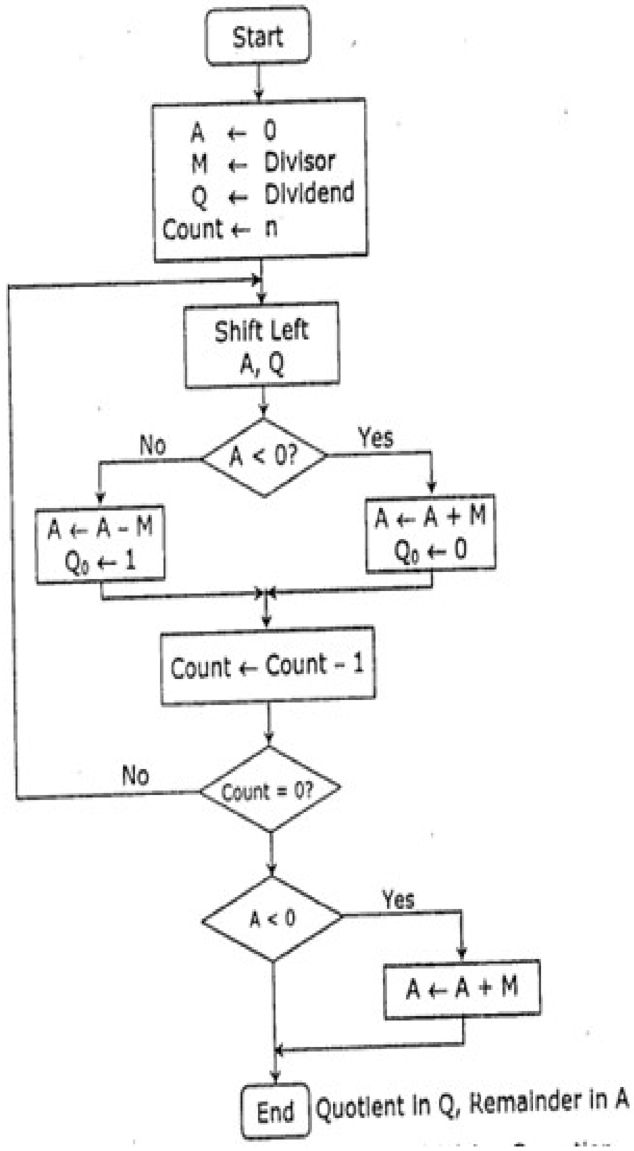
Aim - To implement Non-Restoring division algorithm using c-programming.

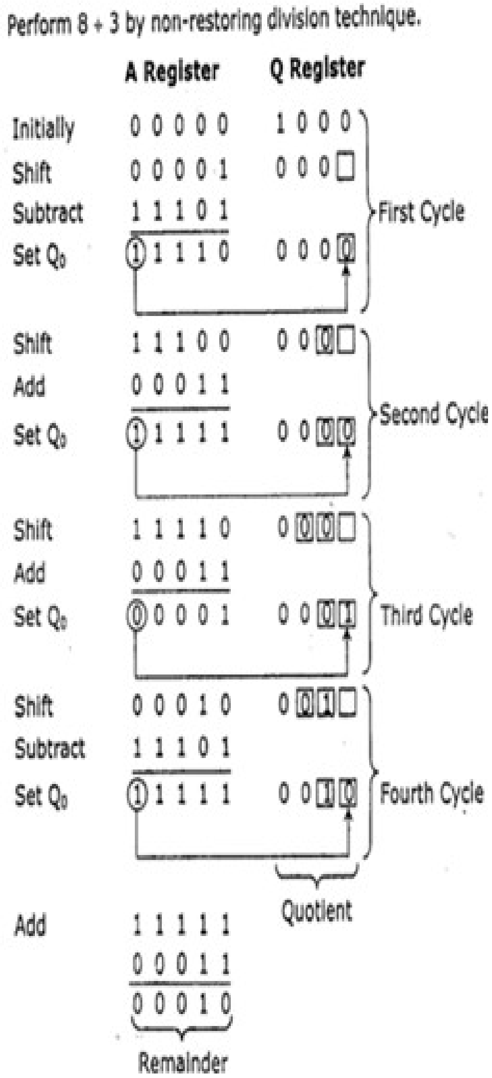
Objective -

- To understand the working of Non-Restoring division algorithm.
- To understand how to implement Non-Restoring division algorithm using c-programming.

Theory:

In each cycle content of the register, A is first shifted and then the divisor is added or subtracted with the content of register A depending upon the sign of A. In this, there is no need of restoring, but if the remainder is negative then there is a need of restoring the remainder. This is the faster algorithm of division.





Program -

```
#include <stdio.h>
#include <stdlib.h>

int dec_bin(int, int []);
int twos(int [], int []);
int left(int [], int []);
int add(int [], int []);

int main()
{
   int a, b, m[4]={0,0,0,0}, q[4]={0,0,0,0}, acc[4]={0,0,0,0}, m2[4], i, n=4;
   printf("Enter the Dividend: ");
   scanf("%d", &a);
   printf("Enter the Divisor: ");
   scanf("%d", &b);
   dec_bin(a, q);
   dec_bin(b, m);
   twos(m, m2);
   printf("\nA\tQ\tComments\n");
   for(i=3; i>=0; i--)
   {
      printf("%d", acc[i]);
   }
   printf("\t");
   for(i=3; i>=0; i--)
   {
      printf("%d", q[i]);
   }
   printf("\tStart\n");
   while(n>0)
   {
      left(acc, q);
```

```
for(i=3; i>=0; i--)
{
   printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=1; i--)
{
   printf("%d", q[i]);
}
printf("_\tLeft Shift A,Q\n");
add(acc, m2);
for(i=3; i>=0; i--)
{
   printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=1; i--)
{
   printf("%d", q[i]);
}
printf("_\tA=A-M\n");
if(acc[3]==0)
{
   q[0]=1;
   for(i=3; i>=0; i--)
   {
      printf("%d", acc[i]);
   }
   printf("\t");
   for(i=3; i>=0; i--)
   {
      printf("%d", q[i]);
   }
   printf("\tQo=1\n");
}
else
{
   q[0]=0;
```

```
            add(acc, m);
            for(i=3; i>=0; i--)
            {
                printf("%d", acc[i]);
            }
            printf("\t");
            for(i=3; i>=0; i--)
            {
                printf("%d", q[i]);
            }
            printf("\tQo=0; A=A+M\n");
        }
        n--;
    }
    printf("\nQuotient = ");
    for(i=3; i>=0; i--)
    {
        printf("%d", q[i]);
    }
    printf("\tRemainder = ");
    for(i=3; i>=0; i--)
    {
        printf("%d", acc[i]);
    }
    printf("\n");
    return 0;
}

int dec_bin(int d, int m[])
{
    int b=0, i=0;
    for(i=0; i<4; i++)
    {
        m[i]=d%2;
        d=d/2;
    }
    return 0;
}
```

```
int twos(int m[], int m2[])
{
   int i, m1[4];
   for(i=0; i<4; i++)
   {
      if(m[i]==0)
      {
         m1[i]=1;
      }
      else
      {
         m1[i]=0;
      }
   }
   for(i=0; i<4; i++)
   {
      m2[i]=m1[i];
   }
   if(m2[0]==0)
   {
      m2[0]=1;
   }
   else
   {
      m2[0]=0;
      if(m2[1]==0)
      {
         m2[1]=1;
      }
      else
      {
         m2[1]=0;
         if(m2[2]==0)
         {
            m2[2]=1;
         }
         else
```

```
        {
          m2[2]=0;
          if(m2[3]==0)
          {
           m2[3]=1;
          }
          else
          {
           m2[3]=0;
          }
        }
      }
   }
   return 0;
}

int left(int acc[], int q[])
{
   int i;
   for(i=3; i>0; i--)
   {
      acc[i]=acc[i-1];
   }
   acc[0]=q[3];
   for(i=3; i>0; i--)
   {
      q[i]=q[i-1];
   }
}

int add(int acc[], int m[])
{
  int i, carry=0;
  for(i=0; i<4; i++)
  {
   if(acc[i]+m[i]+carry==0)
   {
    acc[i]=0;
```

```
    carry=0;
   }
   else if(acc[i]+m[i]+carry==1)
   {
    acc[i]=1;
    carry=0;
   }
   else if(acc[i]+m[i]+carry==2)
   {
    acc[i]=0;
    carry=1;
   }
   else if(acc[i]+m[i]+carry==3)
   {
    acc[i]=1;
    carry=1;
   }
  }
  return 0;
}
```

Output:

Enter the Dividend: 10

Enter the Divisor: 2

A	Q	Comments
0000	1010	Start
0001	010_	Left Shift A,Q
1111	010_	A=A-M
0001	0100	Qo=0; A=A+M
0010	100_	Left Shift A,Q
0000	100_	A=A-M
0000	1001	Qo=1
0001	001_	Left Shift A,Q
1111	001_	A=A-M
0001	0010	Qo=0; A=A+M
0010	010_	Left Shift A,Q

0000 010_ A=A-M
0000 0101 Qo=1

Quotient = 0101 Remainder = 0000

Conclusion -

This experiment and the code implementation of the Non-Restoring Division Algorithm have offered valuable insights into the realm of binary division. We have showcased the algorithm's efficiency in dividing binary numbers without resorting to restoration operations, making it well-suited for hardware implementations where optimal performance is essential. This experiment has not only highlighted the effectiveness of algorithmic improvements in digital computation but has also demonstrated the real-world utility of non-restoring division as a dependable approach for achieving accurate binary division in a hardware setting.