Experiment No. 9
Implement Non-Restoring algorithm using c-programming
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Date of Performance:
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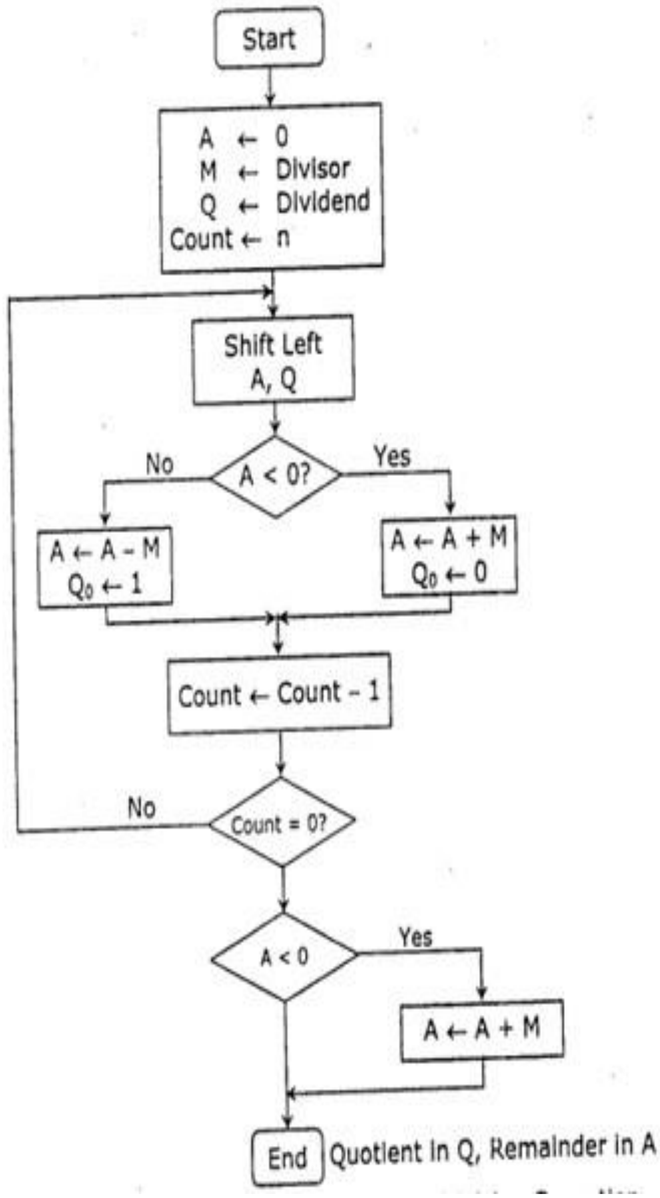
Aim - To implement Non-Restoring division algorithm using c-programming.

Objective -

1. To understand the working of Non-Restoring division algorithm.
2. 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.



Perform 8 ÷ 3 by non-restoring division technique.

	A Register	Q Register	
Initially	0 0 0 0 0	1 0 0 0	First Cycle
Shift	0 0 0 0 1	0 0 0 □	
Subtract	1 1 1 0 1		
Set Q_0	1 1 1 1 0	0 0 0 0	
Shift	1 1 1 0 0	0 0 0 □	Second Cycle
Add	0 0 0 1 1		
Set Q_0	1 1 1 1 1	0 0 0 0	
Shift	1 1 1 1 0	0 0 0 □	Third Cycle
Add	0 0 0 1 1		
Set Q_0	0 0 0 0 1	0 0 0 1	
Shift	0 0 0 1 0	0 0 1 □	Fourth Cycle
Subtract	1 1 1 0 1		
Set Q_0	1 1 1 1 1	0 0 1 0	
		Quotient	
Add	1 1 1 1 1		
	0 0 0 1 1		
	0 0 0 1 0		
	Remainder		

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 code implementation of the Non-Restoring Division Algorithm have provided valuable insights into the world of binary division.We have demonstrated the algorithm's effectiveness in dividing binary numbers without the need for restoring operations, making it suitable for hardware implementations where efficiency is critical. This experiment has not only showcased the power of algorithmic optimization in digital computation but has also illustrated the practical application of non-restoring division as a reliable method for achieving precise binary division in a hardware context.