Experiment No. 9
Implement Non-Restoring algorithm using c-programming
Name: Gautam D. Chaudhari
Roll Number: 04
Date of Performance:
Date of Submission:

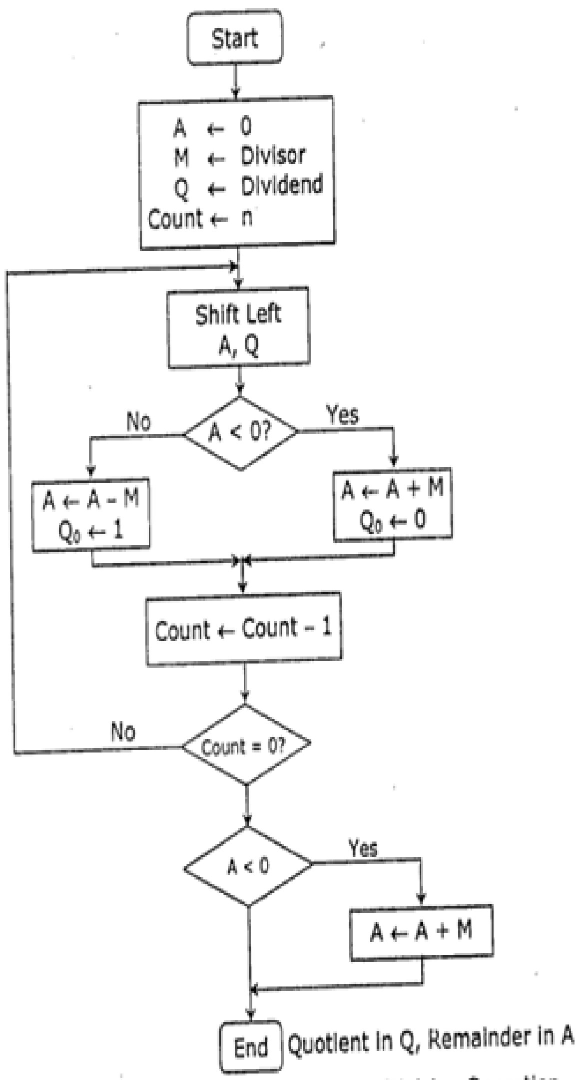
Aim - To implement Non-Restoring division algorithm using c-programming.

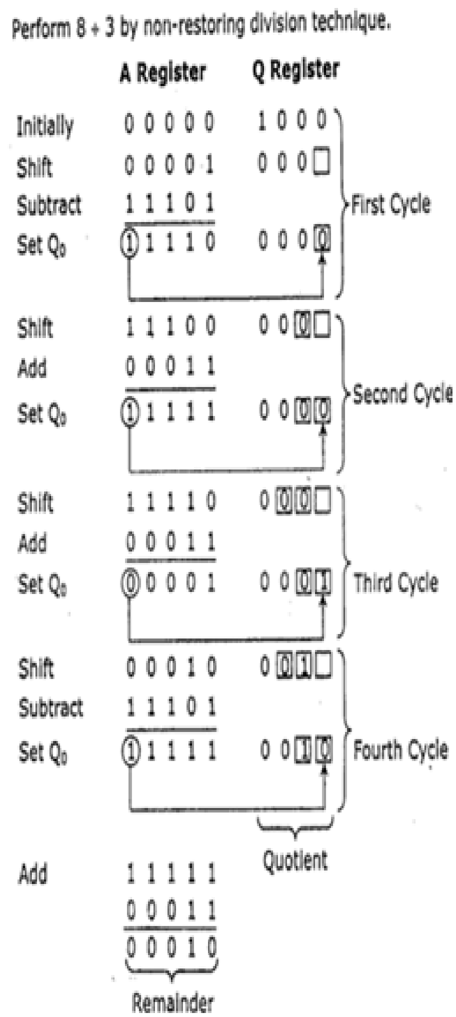
Objective -

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.





Program -

```
#include <math.h>
#include <stdio.h>
int main()
{
int a[50],a1[50],b[50],d=0,i,j;
  int n1,n2, c, k1,k2,n,k,quo=0,rem=0;
    printf("Enter the number of bits\n");
    scanf("%d",&n);
  printf("Enter the divisor and dividend\n");
  scanf("%d %d", &n1,&n2);

  for (c = n-1; c >= 0; c--)//converting the 2 nos to binary
  {
    k1 = n1 >> c;

    if (k1 & 1)
      a[n-1-c]=1;// M
    else
     a[n-1-c]=0;

     k2 = n2 >> c;

    if (k2 & 1)
      b[2*n-1-c]=1;// Q
    else
     b[2*n-1-c]=0;

  }

  for(i=0;i<n;i++)//making complement
  {
      if(a[i]==0)
        a1[i]=1;
      else
        a1[i]=0;
  }
```

```
  a1[n-1]+=1;//twos complement ie -M

  if(a1[n-1]==2)
  {
        for(i=n-1;i>0;i--)
     {
           if(a1[i]==2)
        {
            a1[i-1]+=1;
            a1[i]=0;
        }
     }
  }
  if(a1[0]==2)
    a1[0]=0;

  for( i=0;i<n;i++)// putting A in the same array as Q
  {
     b[i]=0;

  }

printf("A\tQ\tPROCESS\n");

  for(i=0;i<2*n;i++)
{
   if(i==n)
       printf("\t");

   printf("%d",b[i]);
}
printf("\n");

  for(k=0;k<n;k++)//n iterations
  {
     for(j=0;j<2*n-1;j++)//left shift
       {
        b[j]=b[j+1];
```

```
}

for(i=0;i<2*n -1;i++)
{
   if(i==n)
      printf("\t");
   printf("%d",b[i]);
}printf("_");

printf("\tLEFT SHIFT\n");

   if(b[0]==0)
   {
            for(i=n-1;i>=0;i--)//A=A-M
            {
               b[i]+=a1[i];

                  if(i!=0)
              {
                  if(b[i]==2)
                        {
                           b[i-1]+=1;
                           b[i]=0;
                        }
                  if(b[i]==3)
                        {
                           b[i-1]+=1;
                           b[i]=1;
                        }
                       // printf("%d",b[i]);
               }
            }
                  if(b[0]==2)
                     b[0]=0;

                  if(b[0]==3)
                     b[0]=1;
```

```
        for(i=0;i<2*n -1;i++)
        {
           if(i==n)
              printf("\t");



           printf("%d",b[i]);
        }printf("_");

        printf("\tA-M\n");
}

else
{
        for(j=n-1;j>=0;j--)//A=A+M
           {
              b[j]+=a[j];

              if(j!=0)
           {
              if(b[j]==2)
                    {
                       b[j-1]+=1;
                       b[j]=0;
                    }
              if(b[j]==3)
                    {
                       b[j-1]+=1;
                       b[j]=1;
                    }
           }

              if(b[0]==2)
                 b[0]=0;

              if(b[0]==3)
                 b[0]=1;
           }
```

```
            for(i=0;i<2*n -1;i++)
          {
            if(i==n)
              printf("\t");



            printf("%d",b[i]);
          }printf("_");

          printf("\tA+M\n");

    }



       if(b[0]==0)//A==0?
       {
         b[2*n-1]=1;
         for(i=0;i<2*n ;i++)
          {
            if(i==n)
              printf("\t");



            printf("%d",b[i]);
          }

          printf("\tQ0=1\n");
       }



       if(b[0]==1)//A==1?
       {
         b[2*n-1]=0;
         for(i=0;i<2*n ;i++)
```

```
            {
              if(i==n)
                printf("\t");



              printf("%d",b[i]);
            }

            printf("\tQ0=0\n");

        }

 }

if(b[0]==1)
{
          for(j=n-1;j>=0;j--)//A=A+M
              {
                b[j]+=a[j];

                if(j!=0)
              {
                if(b[j]==2)
                      {
                        b[j-1]+=1;
                        b[j]=0;
                      }
                if(b[j]==3)
                      {
                        b[j-1]+=1;
                        b[j]=1;
                      }
              }

                if(b[0]==2)
                  b[0]=0;

                if(b[0]==3)
```

```
            b[0]=1;
        }

        for(i=0;i<2*n;i++)
      {
        if(i==n)
          printf("\t");



        printf("%d",b[i]);
      }

      printf("\tA+M\n");
}
printf("\n");
for(i=n;i<2*n;i++)
{
  quo+= b[i]*pow(2,2*n-1-i);
}
for(i=0;i<n;i++)
{
  rem+= b[i]*pow(2,n-1-i);
}
printf("The quotient of the two nos is %d\nThe remainder is %d",quo,rem);

printf("\n");
 return 0;
}
```

Output:

```
Terminal
Enter the number of bits
4
Enter the divisor and dividend
1010
0010
A    Q    PROCESS
0000    1010
0001    010_    LEFT SHIFT
1111    010_    A-M
1111    0100    Q0=0
1110    100_    LEFT SHIFT
0000    100_    A+M
0000    1001    Q0=1
0001    001_    LEFT SHIFT
1111    001_    A-M
1111    0010    Q0=0
1110    010_    LEFT SHIFT
0000    010_    A+M
0000    0101    Q0=1

The quotient of the two nos is 5
The remainder is 0
```

Conclusion -

The experiment and code implementation of the Non-Restoring Division Algorithm have given us valuable insights into binary division. We showed that this algorithm efficiently divides binary numbers without requiring restoring operations, making it well-suited for hardware where efficiency matters. This experience has not only highlighted the benefits of algorithmic optimization in digital computing but has also shown how non-restoring division is a reliable method for achieving accurate binary division in a hardware context.